HOME OFFICE.—DANGEROUS TRADES COMMITTEE.

THIRD INTERIM REPORT

OF THE

DEPARTMENTAL COMMITTEE

APPOINTED TO INQUIRE INTO AND REPORT UPON

CERTAIN MISCELLANEOUS DANGEROUS TRADES.

Presented to both Houses of Parliament by Command of Her Majesty.

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DANGEROUS TRADES COMMITTEE.

COMPOSITION OF THE COMMITTEE.

HAROLD JOHN TENNANT, M.P. (*Chairman*).

MAY EDITH TENNANT, formerly Her Majesty's Superintending Inspector of Factories.

THOMAS OLIVER, M.D., F.R.C.P.. Physician to the Royal Infirmary, Newcastle-upon-Tyne.

HAMILTON P. SMITH, Retired Commander, R.N., Her Majesty's Inspector of Factories (*Secretary*).

REFERENCE.

THE COMMITTEE WERE DIRECTED BY THE SECRETARY OF STATE TO INQUIRE INTO THE CONDITIONS OF WORK AS THEY AFFECT THE HEALTH OF THE OPERATIVES IN THE FOLLOWING INDUSTRIES AND PROCESSES :—

*India Rubber Works.
*Paper Staining, Colouring, and Enamelling.
*Dry Cleaning.
Basic Slag Works and Manufacture of Silicate of Cotton.
†Electrical Generating Works.
Sole-Stitching by American Machinery.
Glass Polishing.
File Cutting.
*Bronzing and Metallachrome Powder in Lithographic Works.
Flour Mills.
The Use of Converters in Metal Works.
*The Use of Steam Locomotives in Factories.
Licking of Labels for Reels in Thread Mills.
*The Use of Inflammable Paints in Shipbuilding Yards.
Galvanised Iron Works.
The Process of Dyeing with Arseniate of Soda.
The Manufacture and Use of Grindstones and Emery Wheels.
The Use of Lead in various forms in Print and Dye Works.
The Testing of Bottles by Compressed Air.
*The Bottling of Aërated Waters.
The Manufacture of Salt.
"Ending and Mending" in Velvet Works.

And to report what, if any, special rules should be made under section 8 of the Factory and Workshops Act, 1891, for the protection of the persons employed in these industries.

* These subjects were dealt with in the first interim report of the Committee, 1896.
† This subject was dealt with in the second interim report of the Committee, 1897.

1 98389. Wt. 4212.

Third Interim Report of the Departmental Committee appointed to Inquire into and Report upon certain Miscellaneous Dangerous Trades.

To the Right Hon. Sir MATTHEW WHITE RIDLEY, Bart., M.P., Her Majesty's Principal Secretary of State for the Home Department.

1. Since the issue of their Second Interim Report of 1897, the Committee have met and considered the subject-matter referred to them; their further sittings have occupied thirty-four days, making a total since their appointment of one hundred and twenty-eight days. They have visited eighty-one factories and workshops in connection with the trades upon which they now issue their Third Interim Report, and have examined eighty-one witnesses from whom written evidence on the subject-matter of these industries has been taken.

The total number of factories and workshops visited since the Committee's appointment is two hundred and twenty-seven, and the total number of witnesses examined is two hundred and twenty-four.

2. Besides the written evidence alluded to, much valuable information has been given by persons conversant with the industry in question, employers, managers, foremen, and workmen alike, for which the Committee beg to offer their cordial acknowledgments.

3. A considerable amount of time has necessarily been spent by individual members of the Committee in collecting facts and statistics relating to the industries under examination, and in drawing up this Report. No account of this has been taken where the work has not been done at formal meetings of the Committee, nor is it included in the statement of the days occupied by their sittings.

4. The same considerations have governed the deliberations of the Committee in this Report as those mentioned in paragraphs 7–9 of their First Interim Report, 1896, which refer to the considerations arising out of the conditions of the various industries in relation to foreign competition and to the state of the labour market.

5. A perusal of this Report will show that several of the existing evils which have confronted the Committee can only be dealt with by legislation. In recommending that wider powers than those which Parliament has already sanctioned be conferred upon the Secretary of State, the Committee have not lost sight of the terms of the reference under which their labours have been conducted; and all their "Recommendations" are accordingly so designed that they may be carried out by Special Rules under Section 8 of the Act of 1891. Inasmuch, however, as it will be necessary to promote a Bill through Parliament for the acquisition of the powers by which alone the requisite protection can be given to the operatives engaged in some of these industries, the Committee suggest, for the consideration of the Secretary of State, that labour and time might be saved by embodying many of the recommendations themselves in the proposed Bill. By this means the vexation and delay involved in the issue and acceptance of certain Special Rules would be averted. These remarks, besides being applicable to other industries already reported upon, have special reference to two trades dealt with in this Report; to the proposed change in the legal position of the giver-out of work in the file trade, and to the difficulty which would be attached in practice in this trade and in the grinding trade to the issue of Special Rules. Owing to the limited powers of the Secretary of State and the cumbrous machinery of Section 8 of the Act of 1891 the control of these industries by Special Rules is impossible. The occupiers are generally workmen, often weekly tenants, and to such occupiers it is practically impossible to apply the provisions of this section.

FILE CUTTING.

6. The industry of cutting files is performed both by hand and by machinery, and is carried on in many parts of the country, but chiefly in Sheffield. The Committee have visited file cutting shops in London, Glasgow, Rainhill, Cardiff, Birmingham, and in Sheffield.

The Process.

7. In hand cutting the worker is seated at what is known in the trade as a "stock." This consists of a stone block into the centre of which a smaller steel block, called a "stiddy," is inserted, the surface of which is raised slightly above that of the "stock." Upon the "stiddy" the file to be cut is placed. Each individual tooth is formed by a stroke of a heavy hammer on a chisel. In order to support the file while it is being thus heavily struck by the hammer and the chisel a substance between the file and the "stiddy" is necessary which, while it will give a certain amount of resistance to the blow, is not so hard as to cause a recoil. For this purpose what is known as a "lead bed" is used, which consists of a piece of lead varying in size with the size of the file. Two leather straps, fixed on the left hand side to nails firmly wedged between the "stiddy" and the "stock," pass over the ends of the file and hang down on the other side. A stirrup attached to the free ends enables the worker by pressure with his foot to keep the file in position on the "lead bed," and chalk is used to prevent the "lead bed" from slipping on the "stock." If the work is at all heavy, the lead flattens out where the file presses upon it; a groove is thus formed in the lead into which the file fits. When one face has been cut charcoal is rubbed upon it before the file is turned, and when both faces are finished the file is briskly brushed.

8. Where the file is large, and the teeth to be cut are consequently deep, the work is extremely heavy. The hammer weighs 7½ to 8 lbs., even as much as 9 lbs., and it has been calculated that in a day's work a man may lift 190 tons. A 12-inch file requires 3,800 teeth to be cut on it, counting both sides; this, with an 8-pound hammer, would entail the lifting of 13 tons per file.

9. The Committee do not propose to deal with the process of file cutting by machinery, as it is generally carried on in modern "shops" with good ventilation and air space; as the "bed" is of spelter, containing only a small proportion of lead*; and as the operative rarely leans over the file while it is being cut.

The Dangers of Working.

10. The dangers of file cutting are to be traced to several causes, the most important of which is the "lead bed." But there are many accessories to this, which make file cutting one of the most serious subjects into which the Committee have been directed to inquire. The conditions under which the occupation is carried on in numerous instances tend unnecessarily to aggravate the risks of lead poisoning.

Bad ventilation, overcrowding, dirtiness, want of light in the workshops, their close proximity to privy middens,† general disinclination to take precautions, the cramped position in which the work is carried on, the practice of licking the fingers to hold the chisel and of brushing the dust off the cut file, the juxtaposition of the "stocks," dilapidation of the floors and neglect of lime-washing are governing conditions which produce in this industry a vitality as low and a mortality as high as can be found in any industry considered by the Committee.

With so little space between the workers† it is inevitable under existing conditions that they should inhale the dust created by the constant hammering and brushing of files. This dust contains a large proportion of lead as well as chalk, charcoal, steel, and granite, and is found on the floor, and on the "stocks." Even in the dust removed from the rafters careful analysis discloses the presence of lead. Workers in so sedentary an occupation naturally object to the draught caused by the opening of windows immediately in front of or beside them. In the absence of other means of admitting fresh air there is practically no ventilation.

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* *See* Report on file-cutters' spelter or pewter beds in Appendix I.

† *See* Appendix II.

General Remarks.

11. Attention has constantly been drawn during the last 30 years to the dangers attending this trade. So long ago as 1865 a valuable pamphlet was published embodying a paper read before the National Association for the Promotion of Social Science by Dr. J. C. Hall, F.R.C.P. Edin., Senior Physician to the Sheffield Public Hospital and Dispensary, entitled, "The Trades of Sheffield as influencing Life and Health, "more particularly File Cutters and Grinders." The Committee consider the following passages may be quoted with advantage. "In cutting files it is the custom "of the men to wet the thumb and finger of the left hand by putting them to the "mouth and so moistening them with their saliva. At every shifting, and when "the file has to be turned, the lead is handled, and thus in a variety of ways it is "absorbed into the system. They (the men) frequently eat their meals without "washing their hands, and often take dinner in the workshop where the files are cut. "As though fine lead dust, handling the lead at each shifting, and licking the fingers "were not sufficiently poisonous, I saw in one of the file cutter's shops . . . . . "a man, whose wife had just brought him his dinner, eating it with unwashed "hands, and dipping his fingers, blackened and covered with fine lead dust, into a "paper which contained the salt for seasoning his beef. I went this day "(September 25th, 1865) to a file shop in which several men were at work cutting. "These men all take their dinners in the shop—they never wash their hands until they "get home at night—'sometimes not then.' They do not change their clothes when "they get home." After pointing to certain preventives, Dr. Hall concludes his passage on file cutting thus:—"The means of prevention may be considered too simple, "or trifling; but by these and a free use of soap and water, how much of pain, of "sorrow, and of wretchedness to themselves and to their families, might the file "cutters of Sheffield avoid." In alluding to this paper the "Times" stated:— "Dr. J. C. Hall, by his persistent efforts on behalf of these poor people for the last "ten years, has at last forced the public to listen to him." In the light of this statement thirty-three years ago, it is remarkable that until quite recently these conditions remained practically unaltered. The Local Authority have on representations made by the factory inspectors done something to improve the condition of the file cutters' "shops," but there is no systematic sanitary inspection of workshops, and until the duties imposed by Section 3 of the Act of 1891 are undertaken spontaneously and vigorously, radical reformation must be delayed.

12. Coming down to later times, Dr. Sinclair White, F.R.C.S., Eng., D.P.H. Camb., Lecturer on Public Health, Sheffield Medical School, delivered an instructive lecture in 1893 to the Sanitary Institute in London. He states that at that time 4,000 workmen, besides a large number of women, were employed in the file trade. After detailing the evils which the Committee have endeavoured to describe, Dr. White proceeds as follows:—"The ill effects resulting from the employment of lead in "file cutting are only too well known. Colic, paralysis of the extensor muscles of "the wrist and thumb, gout, and Bright's disease, are the most evident of its protean "evils; but long before it produces these definite maladies its influence on the body is "both seen and felt. The sallow, anæmic countenance presented by the file cutter is "almost characteristic of his calling, while inquiry will often elicit a history of "constipation, indigestion, and bodily weakness, long antecedent to the development "of more alarming maladies. By way of sampling file cutters I examined one "hundred men taken haphazard as I met them in their workshops. Their average "age was thirty-seven years, and they had been working at their trade on an average "for twenty-three and a half years. Seventy-four had a lead line on their gums, "twenty-eight had suffered from lead colic, and twenty had at some time been "afflicted with paralysis of the wrist or thumb. These figures, however, do not show "the full extent of the mischief, because file cutters, when they become seriously "paralysed in the wrist are unable to follow their employment, and either take to "some other calling or too frequently become a burden to the community, until a "life of decrepitude and disease terminates in premature death."

General Health of File Cutters.

13. Speaking generally, Dr. Henry Harvey Littlejohn, who for six years filled the post of Medical Officer of Health for Sheffield, says that file makers as a class show evidence of impaired nutrition and health, and, in his experience, it is exceptional to find a robust file cutter. He adds, "I do not mean that they all complain of

" any special form of ill health, but they are for the most part sallow, poorly " nourished, and deficient in muscular development."

Returns of Mortality due to Plumbism.

14. It is uncertain how far the published mortality returns represent the actual facts of the case. Many witnesses might be summoned in support of the view that of necessity these figures can but imperfectly represent the total mortality from the causes under consideration, but the Committee will confine themselves to the authority of Dr. Littlejohn, and of the published Report of the Registrar-General of Births, Deaths, and Marriages for 1897. Dr. Littlejohn says: "That the figures* represent " the total number of deaths which were directly or indirectly caused by lead poisoning " I do not believe, since from the nature and progress of the symptoms it must be " evident that many deaths primarily due to lead poisoning would, in the absence " of a regular medical attendant, be liable to be ascribed to secondary and " dependent diseases."

The Registrar-General, in an admirable report, gives some very interesting figures for file cutters (as well as other classes of workers brought into daily contact with lead), as compared with occupied males in general. He further states " that exposure " to the risk of lead-poisoning is associated with increased liability to disorders of the " urinary and nervous systems . . . . . it is found that those occupations " which show the greatest excess of mortality from plumbism also show the greatest " excess of mortality from diseases of the urinary and nervous systems." He points out that among file makers the combined mortality under these two headings is 316 against 123 for occupied males in general. " *These figures leave no room for doubt that* " *the deaths which are definitely certified as due to plumbism constitute but a small* " *proportion of the deaths really due to poisoning by lead among workers who are exposed* " *to its influence.*"

File Cutting Shops.

15. Of the file cutting " shops " to which attention should be specially drawn, the Committee would again quote from the valuable statement Dr. Littlejohn was good enough to hand in. " Most of these shops are of such a rude and primitive description " that they appear not to have been built for the purpose, and to have been simply " out-houses in the yards belonging to dwelling-houses, which in the absence of " control and restrictions, have been transformed into workshops. They are frequently " built against a blank wall, with a shed or sloping roof so that through ventilation " is impossible, and all light and air is admitted by the windows, which are situated " low down and immediately in front of the bench at which the work is carried on. " Under these circumstances, when the windows are opened, the cold air blows directly " on the workpeople. . . . . The floors often consist only of bricks or earth loosely " laid, and are frequently damp and foul from the accumulation of dust and other " refuse. . . . . I have frequently been told by workpeople that the only way to " make the temperature at all bearable is to block up every opening to the outer air " and to have as many workpeople in them as possible."

Ventilation and Space.

16. The question of ventilation and air space has largely occupied the time and attention of the Committee. It will be gathered from what has preceded that it is difficult to lay too much stress upon these methods of improvement. That there should be a larger distance between the " stocks " than that which obtains in only too numerous instances is admitted. And it has been almost universally agreed that other methods of ventilation than that of merely opening a window should be adopted.

The importance of Cleanliness.

17. The Committee have taken much evidence as to the importance of cleanliness, and all the witnesses have concurred in attaching the greatest value to this as a safeguard. They are indebted to Mr. Charles Hobson, President of the Federated Trades Council of Sheffield, for his assistance. He is of opinion that " special attention should be paid " to cleanliness similar to the regulations enforced in lead mills. . . . . ample provision " should be made for frequent washing, which should be rigorously enforced, also " provision made for dining out of the workshop."

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* *See* Statistics, Appendix III.

18. Mr. Stuart Uttley, the Secretary of the File Cutters' Union, and the Secretary of the Federated Trades Council of Sheffield, after expressing scepticism as to some of the dangers of file cutting, says:—"I am fully confirmed in my opinion that a great deal "of the ill health is the result of their neglect of the most ordinary sanitary pre- "cautions, and the lack of personal cleanliness. In many cases a good bath is almost "unknown."

Two observations suggest themselves to the Committee upon this statement. First, that the opportunities of bathing for persons of this class are not so great as they ought to be, and that, even where public baths are available, generally expense and no little trouble is entailed in utilizing them. Secondly, it should be clearly understood that however clean a man may keep himself, he cannot make certain of immunity from the poison. This being so it is not fair to say that the whole mischief is due to the carelessness of the workers.

Food in File Cutting Shops.

19. The custom of taking into file cutting "shops" food which is frequently eaten at the "stock" has received the careful consideration of the Committee. It is stated that the prohibition of eating food in these places might inflict a certain hardship on persons who live far from their work. The workers, it is argued, will have to stand outside in all kinds of weather to eat their dinner, or else go to a neighbour's house, to a coffee tavern, or to the public-house. But notwithstanding these difficulties, the Committee believe that in making the recommendation which they make below, they are choosing the lesser of the evils. The suggested provision of cupboards in which to keep food might minimize the risks, but once brought into the "shop" it will probably be eaten there, and all the medical evidence has gone to show how important it is that food should not be eaten where it is liable to become impregnated with the poisonous dust. And the hardship imposed on a worker in having to devote a small part of his dinner hour in walking to or from the place where his meal is eaten is in great measure compensated by the advantage derived from the change of atmosphere. Also the workshop can be thoroughly ventilated in the absence of the workers. But even were this not so, the supposed hardship would in any case be incomparably smaller than the risk of his system becoming impregnated with so insidious a poison as lead. Moreover, in permitting a workshop to be used as a dining-room, there is greater chance of the file cutter omitting to wash his hands and face before meals. The Committee feel that this explanation of their views on this difficult point is demanded by the circumstances.

Registration of File Cutting Shops.

20. After a careful survey of the conditions, especially that part of them detailed below, under the heading "*Customs of the Trade*," the Committee are strongly of opinion that a rule as to registration and certificates should be applied to file cutting "shops," similar to that which is required in the case of white lead factories by the Act of 1883. They have accordingly added this to their recommendations.

Substitutes for the Lead-bed.

21. Many substances have been tried as a substitute for lead as a bed upon which to rest the file while it is being cut. Dr. Sinclair White, from whom the Committee received many valuable suggestions, to which reference has been made, stated that for light work paper was used in Germany. Clay and fine sand encased in canvas, wood, copper, vulcanite, and various compounds of india-rubber and gutta percha have been tried and discarded. The Committee have not seen these experiments made, but, in their belief, something more than ordinary trade conservatism has led to the rejection of the substitutes which have been tried. Although zinc and pewter are used for machine cutting, it has been found in practice that these materials are too hard for hand cutting except for work upon the smallest class of files used in watch making, gun making, &c.; in the heavier work there is a recoil, and consequent jar to the worker. It is very difficult, apparently, to secure the right degree of resistance. Not only does this jar arise, but also the face which has already been cut is liable to be spoilt when the file is turned over for work upon the other side. Notwithstanding this, the Committee cannot believe that the resources of science have been exhausted in the endeavour to find a substitute for lead. It is the belief of persons competent to judge that such a substitute would have been discovered and introduced long ago

if any money were to be made by it. Unfortunately lead is so cheap, and the quantity used so insignificant, as to hold out no monetary temptation to would-be discoverers. The Committee hope that scientific men and practical file cutters will turn their attention to this question, for it is difficult to exaggerate the importance of solving it.

Customs of the Trade.

22. A common custom of the trade has attracted the attention of the Committee, and has led the Chairman to consult with the Secretary of State as to the legal position of the persons who are employed under the following circumstances in this industry. The owner of a shed or room lets out the "stocks" contained in it to different persons; it is not unusual for each "stock" to be rented by a different person. Each of these persons may be working for different firms. What is the nature of the place in which they work? If each of these persons is an "occupier," then is the "shop" in which the work is carried on a "workshop?" An essential qualification for a "workshop" is that the employer of the persons working therein should have "the right of "access to or control over the premises, room, or place." But in such a case who is the employer with this right? The Secretary of State replied that the relationship of employer and employed must exist in the shed or room before it can be constituted a "workshop." Where that relationship is found, the law as to workshops would apply; but it should be understood that this application is strictly limited to the part of the shed or room which is rented by a person who employs someone else. This situation, therefore, arises:—In the same room are found workers, some subject to the law, others totally exempt: both classes may be working for the same firm; the physical and sanitary conditions of work are identical; the only difference is that some of the women or young persons rent their own "stocks," whilst the others work for a person who rents their "stocks" for them. This is a condition of things which, in the judgment of the Committee, must be recognised as not only highly undesirable, but calculated to bring the law into ridicule. Where each of the persons engaged is the lessee of the "stock" at which he works, no part of the place is a "workshop," and the only provision which could be applicable to such a place is the requirement as to the list of outworkers which has to be returned no matter where the outworker may ply his calling.

Supposing such premises, room, or section of a room to be, in the eye of the factory law, a "workshop," Special Rules under Section 8 of the Act of 1891 can be made to apply, but not otherwise. The question then arises upon whom can the responsibility of having them carried out be most legitimately placed? The Committee have given much consideration to this question, and have arrived at the conclusion that it will be necessary, for an effective administration of the law, to make the owner responsible for requirements similar to those contained in the sections relating to the owners of "tenement factories" in the Act of 1895. To effect this new legislation will be required, and even were that accomplished many necessary regulations would remain untouched. For though the responsibility for providing certain fixtures, for the sanitary condition of the workshop, and for the affixing of some of the notices and abstracts may fairly rest upon the owner, it is impracticable to make him liable for the employment during prohibited hours of women and young persons.

23. The problem is not limited to this class whose legal position has been under discussion. For, besides these "shops," in which several persons work together, though independently of each other, and besides the large factories where the conditions of work are usually much better, the home is also used as a place in which the file cutter carries on his calling. Many witnesses, notably Dr. Porter, Physician to the Royal Infirmary, Sheffield, and Dr. Littlejohn, called the attention of the Committee to the evils of this practice. Dr. Porter says: "The conditions under "which home work is carried on are probably worse, and it would be more difficult "with them to secure the adoption of preventive measures." Dr. Littlejohn says that home work in the file trade is chiefly done by women in the intervals of their domestic duties. He continues: "Whatever evils and risks there may be in connection with "the trade, these are accentuated in the case of home workers, since the class of "persons engaged in it is generally reduced by poverty, occupying a house of the "poorest description, and where there is neither the income nor the will to secure proper "cleanliness."

The question, therefore, which confronts the Committee is, how can that protection, as regards the period of employment, which the law lays down as imperative for women,

young persons and children in ordinary factories and workshops be secured for these two classes of persons. The two classes, it should be understood, are (i) those who work in their homes, and (ii) those whose legal position is discussed above, *i.e.*, the lessees of " stocks " in a common work place.

(i.) *Home workers.*

24. The places where home work is performed may be divided into three classes :—

1. A dwelling where only members of one family are employed is a " domestic workshop " if the employment is such that were it conducted in a place other than the home, that place would thereby be constituted a " workshop." But where the labour is exercised at irregular intervals, and does not furnish the whole or principal means of living to the family, the private house or room is not thereby constituted a " workshop." The law with regard to domestic workshops is that the period of employment for young persons and children is regulated by Section 16 of the Act of 1878, though by that section labour for young persons is permitted between the hours of 6 a.m. and 9 p.m. With regard to ventilation and air space, meal-times, holidays, abstracts, and notices, &c., the ordinary provisions of the Factory and Workshop Acts do not apply. Nor can Special Rules be enforced in them.

2. A home or dwelling in which persons other than members of one family are employed is a " workshop " to which the ordinary law, both as to period of employment and Special Rules, is applicable.

3. Lastly, homes which are used as workplaces by adults whose hours and conditions of labour are now unregulated and untouched by any law. The Committee do not know of any young persons who work at a " stock " which they have provided for themselves, but in their review of the case they have not ignored the possibility that some exist.

(ii.) *Lessees of " Stocks " in a Common Workplace.*

25. The persons who work at " stocks " which they rent from the owner, are, perhaps, the most numerous class in the file trade. The places in which, and the conditions under which, they carry on their labour, have been fully described above.

(iii.) *Treatment.*

26. Two possible courses have suggested themselves to the Committee; to place the responsibility of seeing that only the hours of labour permitted by the Factory and Workshop Acts, and for executing those parts of the Special Rules which cannot be placed upon the owner, (*a*) upon the workers, (*b*) upon the givers out of work. First, as to the sanitary conditions of these places :—The Committee wish to draw attention to Section 5 of the Act of 1895, which was designed to prohibit employers from sending out work to " any place in which work is carried on for the purpose " of, or in connection with, the business of a factory or workshop," if the place is notified by an Inspector as dangerous or injurious to the health of the persons employed therein. Unfortunately, the intention of the framers of this clause was frustrated owing to the insertion of a proviso at the end, stating that this can only be done in an area where " there are special risks of injury or danger to the health of " the persons employed *and* of the district." In the opinion of the Committee if the word *and* were altered to *or* much good might be effected under the powers of the section.

(*a.*) With regard to the enforcement of the Special Rules and the period of employment, the Committee feel that, in the practical operation of requiring the workers to bear the burden of this responsibility, serious hardship and injustice might result. Shifting the responsibility from those who have the power to those who are practically powerless, would place an unscrupulous employer in an unjustly advantageous position as regards his out-workers. The Committee naturally shrink from placing a person in search of work in the position of having to choose between the acceptance of employment carrying with it necessity for working illegal overtime, with all its responsibilities, and the refusal of such employment, which would probably entail grave want and privation. They, therefore, feel they cannot adopt this course.

(*b.*) After much consideration of the problem, and with the recognition of the important departure from existing practice involved in the solution, the Committee have decided to recommend that the onus of executing these requirements should devolve upon the giver out of work. For the purposes of these duties he should be

considered the occupier of the workshop to which his work is given out, and he should be given the right of access to, or control over, the workshop. The Committee fully realise the drastic nature of their proposal, but they have been impelled to this conclusion by the existence of an evil as widespread as it is menacing, and by the feeling that unless legal responsibility is placed on the person as to whose moral responsibility there can be no question, it is idle to expect real improvement. Protection would be furnished to the giver out of work by Section 87 of the Act of 1878, which exempts an occupier from penalty when he can prove that he has used due diligence to enforce the execution of the Act. This recommendation, it should be understood, is designed to apply to those mentioned under (ii.), viz., the lessees of "stocks" in a common workplace. The first two classes of home workers (vide (i.)) are not in need of this requirement, for both have the advantages of "an occupier" known to the law, upon whom this responsibility can be cast.

As the number of persons included in the third class of home workers is exceedingly small, and as their work is of an intermittent character, the Committee have decided that the circumstances do not demand their regulation. They consequently refrain from making any recommendation for their control.

Conclusion.

27. The situation is full of difficulty and complexity. The spirit of the law is now constantly violated: no redress can be sought where the worker assures an Inspector that the employer for whom he works is not the "occupier" of the "shop" or of the "stock." The Committee would specially emphasise the anomaly described in paragraph 22 by which the protection of the law is given to some workers, whilst to others in the same "shop," the conditions of whose employment are in all essentials identical, this protection is denied. The Committee feel very strongly that in the interests of justice, as between workers, and, perhaps, even more as between manufacturers, and in the interests of uniformity of administration, this state of things ought not to be allowed to continue. No remedy is possible without legislation. And they venture confidently to recommend legislation on the lines which they have sketched, believing that the cause demands it, and that its justification would in a very short time show itself manifest and indisputable. While these systems continue in vogue the Committee feel that anything like a guarantee of adequately safeguarding the health of persons engaged in this industry cannot be expected.

RECOMMENDATIONS.

28. The Committee's recommendations are as follows:—

*(i.) (*a.*) In all existing file cutting "shops," the amount of cubic feet of air space should bear to the number of persons employed therein the proportion of 350 to 1; and

(*b.*) in all file cutting "shops" erected after August 1st, 1899, such proportion should be 450 to 1.

*(ii.) There should be a clear space of not less than 4 feet between the "stocks," measured from the outside extremity of the "stock" to the nearest edge of the adjacent one.

*(iii.) (*a.*) All file cutting "shops" should be provided with adequate methods of ventilation other than by windows, except where the sash or the shutter window system is in use.

(*b.*) Where there is one occupier such occupier, and where there is more than one occupier the occupiers jointly and severally, should see that the "shop" is adequately ventilated.

*(iv.) In or immediately adjoining each file cutting "shop," there should be supplied fixed basins, provided with running water and a waste-pipe; the basins to be in the proportion of one to every five or fraction of five persons working in the "shop." In any place or village where there is no main pipe or running water within one hundred yards of the file cutting "shop," and where it is the custom to use water from a stream or well, the provision of running water should not be required.

(v.) (*a.*) Where the persons in a file cutting "shop" are employed by one occupier, such occupier should provide and maintain an adequate supply of soap, and should provide and maintain in a cleanly condition an adequate supply of towels, and nail-brushes.

* The owner should be responsible for the execution of these duties.

(*b.*) In the case of all other file cutting "shops," the occupiers should jointly and severally be responsible for these duties.

(vi.) The occupiers should take measures to secure that every person employed by them wash his or her hands and face before meals and before leaving the file cutting "shop."

(vii.) The occupiers should set apart and enter in the notice a period of at least five minutes in addition to the regular meal times for washing immediately before each meal time, and also before the end of each day's work, and they should see that it is observed.

(viii.) (*a.*) All file cutters should wear overall suits; these should be supplied by the occupier.

(*b.*) Where the persons in a file cutting "shop" are employed by one occupier, such occupier should be responsible for the maintenance of the overalls in a cleanly condition, and for their being washed not less than once a week.

(*c.*) In the case of all other file cutting "shops" the occupiers should jointly and severally be responsible for this duty.

(ix.) (*a.*) Where the persons in a file cutting "shop" are employed by one occupier, such occupier should see that the "shop" is kept in a cleanly state; the walls and ceiling should be lime-washed at least once every six months.

*(*b.*) In the case of all other file cutting "shops," the owner should be responsible for the lime washing of the file cutting "shop."

*(x.) The floors of all file cutting "shops" should be paved with flagstones, cement, asphalte, or concrete, or boarded with wood, and kept in an efficient state of repair.

(xi.) No meal or food should be taken into or eaten in a file cutting "shop."

(xii.) On and after the first day of January 1899, the business of file cutting by hand should not be carried on in any room or place without a certificate granted to the owner by the Inspector of Factories for the district, stating that the law, so far as it relates to such owner, has been complied with; and if, after the granting of such certificate, it should appear to an Inspector that all or any of such requirements are no longer observed, a Secretary of State may authorise an Inspector to cancel or withdraw the certificate.

(xiii.) An official notice explanatory of the dangers of the trade, and of the importance of conforming to the regulations, should, as well as the regulations themselves, be affixed in all file cutting "shops" in such a position as to be conspicuous and easily consulted by the workers.

GALVANIZED IRON WORKS.

29. This trade is carried on in many parts of the United Kingdom, but chiefly in Birmingham and the Black Country. The articles produced consist of sheets, which may or may not be eventually corrugated, wire, buckets, baths, pails, and other hollow-ware articles.

The Process.

30. The sheet, bucket, or other article to be galvanized has to undergo a preliminary process known as "pickling." This consists of plunging it into a solution of hydrochloric acid, which cleans the iron and prevents the presence of oxygen when it is dipped into the galvanizing metal. The solution of acid is not very strong, but its pungent fumes rise in sufficient quantities, both in volume and density, to be unpleasant.

31. After "pickling" the iron article is ready for galvanizing. The vessel which contains the metal for this purpose consists of a large iron tank, commonly called the galvanizing bath. This is heated sometimes by a coal furnace, but more usually coke is employed. The Committee have seen flues connected with the furnaces, but where coke is used the furnace is open and surrounds as well as underlies the bath.

* The owner should be responsible for the execution of these duties.

Inside the bath the spelter or zinc is placed, and, to prevent oxidation, handfuls of ammonium chloride are thrown on to the surface of the molten metal. These at once give off thick clouds of their vapour. The article, having been carefully dried, is slowly dipped into the molten zinc, where only a few moments are sufficient for its surface to be completely coated with the bright and shining metal. A bath of cold water completes the process.

The Dangers of Working.

32. Works in London, Glasgow, Liverpool, Birmingham, and the Black Country, have been visited by the Committee, where evidence was taken from employers and workmen.

33. This evidence, supported as it is by the analysis,* does not lead the Committee to believe that serious consequences ensue from the inhalation of the mixture of gases and vapours generated in the process described above. The complaints from which the workers suffer are those, such as bronchial and chest affections and rheumatism, which are necessarily incidental to any occupation conducted in open sheds where alternate exposure to great heat and cold draughts cannot be avoided. While, therefore, the Committee do not consider this an industry which should be scheduled as a "dangerous trade," and are consequently not prepared to recommend Special Rules for its control, they nevertheless think that certain observations may be made with profit.

General Remarks.

34. In certain works visited by the Committee cowls or hoods are in use, some of which are connected with mechanical fans. These devices for ridding the workshop of part of the fumes have been adopted both over the "pickling" vats and the galvanizing baths. The Committee consider that such a system is distinctly desirable, and they would like to see its widespread introduction encouraged. They have arrived at this conclusion in spite of the statement of some witnesses that such efforts to ventilate workshops were doomed to failure, and that experiments which had been tried were abandoned as fruitless. The Committee feel assured that the use of defective mechanical appliances led to the adoption of this view; for it is matter of common engineering knowledge that a fan which is not in proper working order becomes a hindrance rather than a help towards ventilation. In this case especially, unless proper care is taken, the acid fumes, by their corroding action, interfere with the working of the fan. It is obvious, then, that when the fan fails, ventilation is almost annihilated, as the natural openings in or near the roof are generally closed to assist the suction power of the fan, and as the movement of air immediately above the bath or vat is obstructed by the cowl.

35. Mr. T. Turner, A.R.S.M., F.I.C., who for upwards of ten years was Demonstrator in Chemistry at Mason College, Birmingham, introduced a process for recovering hydrocholric acid from waste pickle. He states that "the fumes from the galvanizing "bath can be very much reduced by placing a hood over the bath, and employing "a current of air. If this air is washed in water a quantity of ammonium chloride "can be obtained on evaporation," which, according to information which had reached him, was sufficient to defray the cost of the process. Reference to this process will be found in Thorpe's "Dictionary of Applied Chemistry," Vol. III., p. 1050. The Committee have endeavoured, without success, to find this system at work, and they regret, therefore, that they are unable to offer evidence in confirmation of the statement.

36. Owing to the great volumes of smoke, fumes, and gases, which are chiefly attributable to the ammonium chloride, and which, upon a dull or heavy day, are oppressive, the Committee do not consider that work in a galvanizing shop is good for young and growing boys or girls; nor do they consider it a desirable place in which to eat meals. The Committee would refer to their statement that they are without evidence upon which to recommend Special Rules for the control of this

* *See* Appendix IV.

industry, but, inasmuch as representations have been made to them on the two points referred to above, they venture to appeal to employers to avoid engaging young persons and children, of whom it should be added there are but few employed, and to provide some room or place in which the workers can sit down and have their meals away from the fumes.

37. Many of the workers, and some of the employers, have stated that the fumes from the coke furnaces which heat the galvanizing baths are injurious, but when these become excessive, iron plates are put over the part which is red hot, and it is said that the fumes are thereby diffused. The Committee made this possible source of danger the subject of careful inquiry, and they found that none of those who spoke to the injurious nature of these fumes had personally suffered from them; nor did they find any worker who had so suffered.

SOLE-STITCHING BY AMERICAN MACHINERY.

38. Among the many clever devices which the modern development of machinery offers to manufacturers few are more ingenious than the "Blake Sole-Stitching Machine."

39. The Committee have visited boot and shoe factories in London, Leicester, Manchester and Salford, and in Scotland, and have taken a considerable amount of evidence on the subject.

The Process.

40. The "Blake" machine differs from ordinary boot sewing machines in that it is provided with a moveable arm, called the "horn," through which the twine for sewing passes. The "horn" moves upon an axis in a socket, and by this means the work of sewing the sole to the "upper" is continued without cessation while the heel is being turned by the worker. To give strength and durability to the work it is necessary that the twine used should be waxed; and to procure ease in working it is necessary that the wax should be soft. This result is obtained by the application of a small gas jet to the base of the "horn." The whole "horn" is thus heated to a considerable temperature. It has been found in practice that the gas must pass through the socket in which the "horn" turns upon its axis, and to prevent escape of gas mercury is placed in this socket. It is owing to this fact that the attention of the Committee was directed by the Secretary of State to the use of the "Blake" machine.

41. Several other machines perform the work of sole stitching, such, for example, as the "Pearson," and the "Fortuna" in which no mercury is used. In a combination of the "Stanley" and "Blake" machines water is used in the joint instead of mercury. In some cases the twine is placed in a box containing rosin and tar, which is heated from below either by gas or by methylated spirits. There are other machines for sewing the welts called "Welting Machines," but there is no moveable horn on them, so the Committee do not consider it necessary to describe these various machines in detail; this also applies to the "Fair" stitching machines, which stitch the welt and the out-sole together. They refer to Appendix V., in which will be found sketches of both the old and the new "Blake" sole-sewing machines. For these they are indebted to the English and American Machinery Company, Limited.

The Dangers of Working.

42. It was represented to the Committee that the heat from the gas jet causes vaporization of the mercury; and that the inhalation of this vapour is injurious to the health of the operatives.

While the Committee have had complaints made to them of disagreeable results from the escape of coal gas, most commonly caused by an insufficient supply of mercury in the socket, the evidence as to mercurial poisoning was limited to two cases, and was not conclusive. In these cases death had occurred some time before the Committee's inquiry, and the evidence as to the cause was contradictory; fellow workmen were of opinion that, in the one case, death was due to drinking, and, in the other, to inherited consumption. These men had continued work in the same employment for eighteen or twenty years.

43. The Committee, bearing in mind the alleged connection between lung disease and mercurial poisoning, have directed their attention to the prevalence of phthisis in this industry. The figures* show that nearly one-fifth of the shoemakers who die, die of phthisis, and that, while the mortality from this disease among occupied males is 185 and among agriculturists 117, the corresponding figure for shoemakers is 256. But, as has been stated, the Committee have no conclusive evidence to show that the "Blake" machine has caused any mercurial poisoning; and inasmuch as but one case of phthisis has been alleged to have proceeded from the use of this machine, there is no ground for supposing that the high mortality from phthisis is due to its presence.

General Remarks.

44. The Committee desire to thank Mr. Butcher of the Co-operative Wholesale Society's Wheatsheaf Works, Leicester, for his evidence and for the information he has been good enough to send them. They are also indebted to Dr. Carl Otto Weber of the Greengate Laboratory, Salford, for interesting scientific evidence on this subject. They would extend their acknowledgments to him for the valuable time and experience he placed at their disposal. They find, however, that the evils complained of are strictly limited to the few individual cases that came under his notice, about which, as has been stated, the evidence was conflicting, and that mercurial poisoning as a result of using American sole stitching machinery was elsewhere unknown.

45. The Committee are of opinion that although the trade is not one which demands the control of the Secretary of State by Special Rules, there is great necessity for the careful enforcement of the requirements of Section 3 of the Act of 1878, and amending sections, which deal with purifying the air from gases, vapours, dust, and other impurities.

GLASS POLISHING.

46. After glass has been cut, whether it be the bevelled edge of a mirror or of a shop front fitting, a wine glass, a chandelier, or a flower vase, it must finally undergo the process of polishing. The Committee have seen the different methods of polishing carried on in London, Birmingham, and St. Helen's.

The Process.

47. The polishing of glass is done on a revolving wheel or table made of wood, usually boxwood, upon which either rouge or what is known as "putty powder," mixed with water, is allowed to drip. When the article to be polished is a plane surface with a bevelled edge, such as a mirror, the wheel is a horizontal one revolving on a vertical axis. It is not generally less than about fifteen inches in diameter, and may be double that size, though this is unusual. The water and "putty powder" or rouge, as the case may be, are contained in a small conical-shaped vessel, and passed through a narrow opening at the bottom, by means of which the supply is

* *See* Supplement to Annual Report of Registrar-General of Births, Deaths, and Marriages, Part II. *N.B.*—The figures refer to the years 1890-92.

regulated. Where any finely cut work, such as wine glasses, cut globes for electric light, &c., are being polished the work cannot be done on a "wood," as the horizontal wheel is termed, but it is performed by means of a hard brush attached to the outside rim of a small vertical wheel from four to six inches in diameter, revolving at a high speed on a horizontal axis. For this kind of polishing only "putty powder" is used, which in some cases is "fed" on to the brush by a boy, but there is a very simple automatic arrangement which performs this work with ease and economy. The Committee have seen the whole apparatus boxed in and provided with a fan to draw away the spray given off by the revolving brush. Reference to this system will be found below. In the manufacture of mirrors "putty powder" is also used for taking out stains before silvering. It is sprinkled on in a dry form from a box with a perforated lid; water is also sprinkled, and the surface is rubbed with a wooden block about four inches square, provided with a felt bottom.

The Dangers of Working.

48. As the "putty powder" is largely composed of lead* the danger arising from the occupation is considerable. Rouge,† on the other hand, is considered to be innocuous. The wheel, whether of plain wood or carrying a brush, revolves at a considerable speed, so that the moist paste is scattered freely about in the form of spray.

So far as bevelled plates are concerned, the Committee are glad to be able to report that "putty powder" is being to a large extent superseded by rouge. But it is said that for other purposes, *i.e.*, in the smaller and finer work, "putty powder" is necessary. Even some of the bevelled edge polishers state that the "finish" and "colour" obtained with rouge is not so good or bright as that obtained with "putty," and that more time is required for polishing with rouge. This was not the universal belief or impression, for several witnesses stated that rouge does the work quite as well; that the polish obtained is just as bright; that rouge is cheaper, and that "putty powder" ought to be abandoned.

49. Quite recently a powder containing but traces of lead, which is supplied by Messrs. Johnson, Matthey & Co, of Hatton Garden, E.C., has been brought to the notice of the Committee.* Several firms of flint glass makers, at the request of Mr. J. H. Rogers, Her Majesty's Inspector for Manchester, undertook to give it a trial. They report that they find it quite as efficient as the old "putty powder." But, inasmuch as water containing ·17 grain of lead per gallon has been proved to be dangerous to health, the Committee are not prepared to state that the use of this powder containing as it does 0·02 per cent. of lead would be wholly unattended by risk. They have communicated with Messrs. Johnson, Matthey & Co., who express their willingness to prepare this powder free from lead and to guarantee it as such. It is the Committee's intention that the users of this new leadless powder should be exempted from conforming to the Special Rules.

General Remarks.

50. The knowledge that "putty powder" is dangerous is general; and many of the witnesses spoke of their friends having suffered from colic. It may not be generally known that the dust arising from "putty powder" is almost as harmful as white lead itself. Dr. Oliver, in his experiments, found that animals succumbed to the influence of "putty powder" almost as quickly as to that of carbonate of lead, and when it is known that the powder employed in many glass polishing works contains as much as 70 per cent. of oxide of lead, the fact is not surprising. The Committee also saw witnesses who had been off work several months from lead poisoning, notably one who had had to give up the trade five years ago owing to continued colic and finally wrist drop in both hands. This man, who had five children, had previously been earning 30*s.* a week, and now made about 2*s.* a day in any odd job he could find, such as that of a bill distributor, sandwich man, &c. No washing appliances were supplied in the works where he was employed.

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* *See* Analyses of "Putty powder" in Appendix VI.

† *See* Analysis of Rouge in Appendix VII.

51. The Committee are further indebted to Mr. J. H. Rogers for a report of the case of the death of a "putty" polisher under suspicious circumstances. He was seized with a fit in the factory on 5th February 1898, and died the day after. The medical man who attended the case gave a certificate of death from "epilepsy," though there had been no previous attack, and he knew of the nature of the man's employment. The attention of the coroner was directed to the matter, and he ordered a *post mortem* examination. An inquest followed, and the verdict found was "accidental "death from lead poisoning." The evidence of Dr. E. S. Reynolds, who made the *post mortem*, was to the following effect: — "Deceased was a spare man; blue lines upper "and lower gums; kidneys in an advanced state of chronic inflammation; left side of "heart much enlarged; brain much congested. Opinion—Death due to convulsions "caused by chronic Bright's disease from chronic lead poisoning." Deceased had always been careful to wash himself and was very temperate in his habits. He did not use much "putty powder" himself, but it was constantly used by others in the "shop" where he worked. The coroner severely condemned the practice of medical men not stating the primary cause of death in their certificates.

52. It will thus be seen that all persons employed in places where "putty powder" is used, though themselves not handling it, are liable, through inhalation of the dust, to illness and even death through juxtaposition with those engaged in its use. Under existing circumstances the wet powder splashes on to the clothes not only of the polisher who uses it, but on to those of his neighbours; it gets dry after a time, comes off in fine dust, and enters the system, either by inhalation through the lungs, or by swallowing, or through the pores of the skin.

53. The Committee would further refer to the case of a man who, in the course of 18 or 20 years in this trade, had suffered four times severely from lead colic. He was always a careful man as to cleanliness and as to changing his clothes on going home. During his last illness the doctors did not expect him to recover, but owing to the kindness of friends, who sent him to a convalescent home, he is now well. The firm by whom he was employed have now abandoned "putty powder" in favour of rouge.

54. The Committee desire to tender their acknowledgments to Mr. Alfred Osler, of Birmingham, to Mr. Haddleton, the secretary of the Glass Bevellers' Association, and to Mr. Murray, of Messrs. J. Walsh, Walsh & Co., the chairman of the Midland Association of Glass-workers, from each of whom they have received interesting and valuable evidence.

55. It will be obvious from what has been said that cleanliness is of great importance. The Guardians of the Stourbridge Union wrote to Mr. J. E. Ashworth, H.M. Inspector at Wolverhampton, stating that they had then (28th January 1898) "on their books "several cases of lead poisoning resulting from employment in glass cutting shops." They point out that the danger would be much minimized if running water were used both in the process and for washing. In some cases the changing of clothes and the wearing of overalls were recommended by the workers. The men say they would wear overalls if they were supplied. Soap, water, and towels are supplied by some firms but not by all. The Committee consider it essential that every facility for washing should be provided by the employers, and that no man should be allowed to eat his meals without having previously washed his hands and face.

RECOMMENDATIONS.

56. The Committee therefore venture to submit the following recommendations as a basis for Special Rules where "putty powder" is used:—

(i.) No young person should be employed in handling or using "putty powder."

(ii.) Overalls should be supplied by the occupier to all persons engaged in the room or place where "putty powder" is used. The occupier should be responsible for their being maintained in a cleanly condition, and for their being washed not less than once a week.

(iii.) No food should be taken into or eaten in the room or place where "putty powder" is used or has been used during the day.

(iv.) In all places where "putty powder" is used, there should be supplied by the occupier fixed basins provided with running water and a waste pipe; the basins to be in the proportion of one to every five or fraction of five persons employed in the place where the "putty powder" is used. The occupier should provide and maintain an adequate supply of soap, and should provide and maintain in a cleanly condition an adequate supply of towels and nail-brushes.

(v.) The occupier should set apart and enter in the notice a period of at least five minutes in addition to the regular meal times for washing immediately before each meal-time, and also before the end of each day's work, and he should see that it is observed.

(vi.) The occupier should take measures to secure that all persons engaged in a room or place where "putty powder" is used wash his or her hands and face before meals, and before leaving the works.

(vii.) In polishing glass by means of a revolving brush with "putty powder," the process should be carried on in enclosed cupboards or boxes provided with tubes and a fan, so arranged that the draught shall carry the spray away from the face of the worker.

(viii.) In the same process the "feeding-up" of the "putty powder" and water on to the brush should be done automatically. No handling whatever should be permitted.

(ix.) All persons engaged in the department where "putty powder" is used should be examined once a month by the certifying surgeon for the district who shall have power to order temporary or total suspension.

(x.) A register should be kept showing the date and result of his visit and any requirement made by him.

THE USE OF CONVERTERS IN METAL WORKS.

57. The dangers of steel manufacture by the Bessemer process were brought conspicuously under the notice of the Secretary of State by the fatal accident which occurred at the Dowlais Works in August 1895.

The Committee have visited steel and iron works in Cardiff, Merthyr Tydvil, Dowlais, Ebbw Vale, Newport, Blainavon, Sheffield, Rotherham, also on the Tees and on the Tyne. They have had the advantage of seeing some of the largest industrial undertakings in the world, where vast capital, unequalled experience, and wonderful ingenuity have combined to produce in the manufacture and handling of masses of molten and of red-hot metal an immunity from accident which is remarkable. Mighty ingots of nearly white-hot steel, seething cauldrons of molten metal cannot be conveyed from one process to another, cannot be beaten or rolled into rails or armour plates, or be poured into moulds or into ladles for further distribution, without risk or danger. When it is remembered that the slightest blunder, or the most trivial negligence in the construction, care, or handling of the machinery might cause a vessel containing molten steel, to deal out death to every person engaged in the process, it is most creditable to all concerned that there are such long periods without casualty. The Committee feel that these large employers of labour are to be congratulated on the success which has attended their efforts to use precautions against accident, and on their willingness to adopt further precautions.

58. The Committee wish to express their acknowledgments to many directors, partners, managers, and workmen for the assistance universally extended to them. To Mr. A. Lewis, H.M. Inspector for the Swansea district, they are especially indebted for the experience and ability which he placed at their command.

The Process.

59. So much has been written in scientific works, in the publications of learned and commercial societies, in reviews and trade magazines, on the manufacture of steel by the Bessemer process, that the Committee do not consider it necessary to enter into the details of this remarkable invention. The Bessemer converter is a huge pear-shaped vessel, about 19 feet long by 7 or 8 feet in diameter, into which pig iron and other ingredients for the manufacture of steel are run in a liquid condition. In the bottom of the converter are holes known as "tuyere holes," through which a fierce blast of air, having a pressure of about 21 lbs. to the square inch, is driven into the molten pig iron. The object of the process is to burn out all the impurities in the pig iron, such as carbon, silicon, phosphorus, &c., by a method which develops, in so doing, a degree of heat sufficient to keep the purified metal still liquid. Before the blast is turned on, and after the charge of metal has been inserted the converter's position is altered. It is to the altering of the position, both now and at later stages, and to the methods by which this is attained, that the attention of the Committee was directed. The converter assumes an almost upright position before the blast is turned on. A tremendous roar follows the blast of air; volumes of yellow, brown, and red smoke and flame leap from the top of the converter, and sparks of molten iron rain down into the pit below. The colour of the smoke keeps changing until only flame and myriads of sparks fly upwards and fall again in fiery showers. Finally the flame becomes white, and the blast is withdrawn, after which spiegel iron is introduced into the mass, by which a certain required quantity of manganese and carbon is added to complete the chemical change. The converter has to be lowered in order to pour the liquid steel into a vessel known as "the ladle." From this again it is poured into moulds, by which it is cast into ingots to be manufactured into any article required.

The Dangers of Working.

60. To move the converter and the centre crane which carries the ladle into the required position, sometimes steam power, but more usually hydraulic power is used. Where steam power is used a worm screw is employed with such a pitch that whether at rest or in motion the vessel cannot jerk, so long as the apparatus is in good working order.

Hydraulic power, on the other hand, is conveyed through pipes known as "pressure pipes," and is controlled by a "three-way valve" worked from a platform, upon which there is a signal box termed "the pulpit." The pressure can at will be made to act on either side of the piston. In some cases the piston is stationary and the cylinder in which it works moveable, whilst in other and more numerous cases the cylinder is fixed and the piston moves. In the former case the cylinder is provided with cogs which work in other cogs on the side of the converter. Where the piston is moveable, it works a ratchet bar, the cogs on the bar again working in cogs on the side of the converter, which by this method can be tilted with great ease and steadiness so long as the mechanism is perfect. Any flaw in the pressure-pipe, or sudden failure of pressure, would cause the converter to jerk, and would probably lead to serious or fatal results. It is, therefore, of great importance that there should be some system of automatically locking the converter so that when such failure arises a catastrophe may be averted. This applies with equal force to the centre crane as well as to the converter.

The Committee have seen various kinds of safety appliances in use: some applied only to converters and not to centre cranes, others applied to both. But in certain cases there were no such precautions taken. A description of the several automatic lock arrangements will be found in the Appendix.*

61. The accident at the Dowlais works has been referred to in the opening remarks. In this case there was no fracture or failure of the pressure pipes; the inquest disclosed that while the converter was being lowered from the vertical to the horizontal position, the "wheelman" in the pulpit, who was a youth of 17, allowed it to descend a foot and a half below the required position. He suddenly reversed the wheel, causing one-and-a-half tons of molten steel to be spilt by the jerk; the metal was

* *See* Appendix VIII.

precipitated into the pit, where a number of men were at work preparing the ingot moulds to receive the contents of the converter. Several of the men were severely burnt, and four died from the effects. In the judgment of the Committee so gravely responsible a task, upon the performance of which the limbs and lives of many men depend, should not be entrusted to a young lad.

Some years ago an accident occurred at one of the large works on the Tees, by which 15 men were severely burnt and 10 killed. Ten tons of molten metal fell into the pit owing to the want of some automatic safety valve in the hydraulic machinery. This firm now use a Phillip and Evans patent automatic cut-off gear.

At one of the South Wales works three years ago a converter containing ten tons of metal was jerked in such a way that three tons fell into the pit. There was only one man there at the time, and he was fatally burnt. Safety appliances are now in use for the converters, although the firm have not adopted them for the centre cranes.

General Remarks.

62. From what has been said it will be seen how important it is that where such extremely dangerous materials are in constant manipulation every precaution against accident should be taken, and this is realised by employers and managers. The Committee deplore the system under which the workpeople have their dinner or tea brought to them in the works by small children, On a winter's evening when all the ordinary dangers of a large steel works are intensified by darkness and by shadows thrown from great ingots of white hot metal carried by travelling cranes, when engines and trucks are continually passing to and fro, when sparks are flying from the converter or from under the steam hammer, when rolling mills are alternately shooting out their long red-hot rails and drawing them in again, in all this din and confusion the life of a child is in peril. It is sufficiently dangerous in daylight for adults who can appreciate the danger, but, obviously, it is no place for children. A large number of manufacturers are alive to this danger, and have forbidden the entrance of children to the works, and the Committee trust that others, who have not yet done so, will follow this example.

63. Again, the Committee are of opinion that when the metal is being poured from the converter into the ladle, workmen should not be allowed to stand in the pit below. This practice also is commonly forbidden by employers, though in some works the pits are provided with refuges into which the men retreat during pouring. There is no objection to this system if it is not made an excuse for remaining in the open pit.

64. As has been indicated above, the Committee feel very strongly that only experienced men should be in charge in "the pulpit."

65. In every automatic safety apparatus the spindle in the valve should be changed every three months, as it is submitted to considerable wear and tear, and the valves themselves should be examined by a competent engineer at least once a month.

66. The Committee observed that in certain works the pits were not covered over. The moulds for the ingots usually stand in the pit, and after heavy rain there would be a considerable quantity of water standing where the moulds rest. If this were so when the molten metal is poured, great danger would result to the by-standing workmen, for it is well known that a violent explosion follows if molten metal fall into water. This danger might, to a large extent, be overcome if the bottom of the pit were provided with drains and covered to the extent of about 18 inches with sand or crushed granite. The Committee are led to this belief by the analogy from pig-iron manufacture, where the molten metal is run from the blast furnace direct into sand moulds. So far as they are aware, this process has led to no explosion. They have therefore concluded to recommend that, in the absence of a roof, the pit, should be treated as described above.

RECOMMENDATIONS.

67. The Committee consider that Special Rules based upon the following recommendations should be applied to this industry :—

(i.) All converters and centre cranes moved by hydraulic power should be provided with an automatic safety apparatus, which, in the event of a fracture or a failure of the pressure pipes, would prevent the vessel from jerking or spilling its contents.

(ii.) No person should be placed in control as wheelman in "the pulpit" who has not been carefully trained, nor should he be allowed to assume charge till he has attained the age of 21 years.

(iii.) While the converter is being lowered preparatory to pouring, and during pouring, no one should be allowed to remain in the pit.

(iv.) All pits in which ingot-moulds are placed for filling should be roofed over, or efficiently drained and covered to a depth of 18 inches with sand or crushed granite.

(v.) All hydraulic pressure pipes should be composed of wrought iron.

(vi.) All safety valves for hydraulic machinery should be examined by a competent engineer not less than once a month; the valve spindle should be changed every three months.

THE MANUFACTURE AND USE OF GRINDSTONES.

68. In making this reference to the Committee the Secretary of State has distinguished between the "manufacture" and "use" of grindstones. This distinction is not rendered necessary by the occurrence of accidents in the production of the stones at the quarry. It has never been suggested that there are more accidents in quarries where grindstones are produced than in any other class of quarries, but upon the action of the quarrymen the safety of life and limb of many workmen depends. Numerous grindstone accidents, most distressing in their consequences, might be avoided by the care, diligence, or foresight of the quarry owners or their managers in discovering and condemning defective stones.

The Process.

69. Any steel tool, from a needle to a sword-blade, and many large surfaces, such as stove grates and certain classes of armour plating, have at one period of their manufacture to undergo the process of grinding. The chief centre of the trade, as is well known, is Sheffield, and the Committee have also visited Birmingham and Redditch, where grinding is largely carried on. Buildings in which grinding is done are called indifferently "wheels" or "hulls" in Sheffield, "mills" in Birmingham.

70. Great variations as to speed are to be found, from that at which a stone is turned by hand, to the enormous velocities used in needle and fish-hook grinding at Redditch. In the latter class of work, and in many grinding processes in Sheffield, 1,500 revolutions per minute for a stone of 30 inches in diameter is a common speed. This gives a surface velocity of 11,700 feet per minute. Large stones, 6 feet in diameter, are run, approximately, at 200 revolutions per minute, from which a surface velocity of 3,700 feet per minute is attained. From this it will be seen that there are almost as great variations in the size of stones as in their speed, depending on the nature of the work. It is found necessary for certain classes of work, such as the grinding of forks, augers, hammers, steel "toys," needles, and hackle pins, in razor shaping, and in certain processes of scissor grinding, to run dry stones.

71. While at work the grinder sits astride a massive wooden block called the "horse."* This is chained down either to the brickwork of the floor or to the trough with heavy iron chains varying in thickness up to one inch. The stone revolves in what is known in Sheffield as a "trow," in Birmingham a "stone hole," and may be fixed on to the axle by means of wedges or of plates. In Sheffield only small stones are fixed with wedges, while in Birmingham either wedges or plates are used without regard to size. The axle hole may either be round or square. It is usual to find round holes in large stones and square holes in the smaller stones.

72. The stone revolves upon a shaft or spindle to which motion is given by a pulley upon the same spindle. The belt passes over the pulley, and also over the drum on the line of shafting. The pulleys can be changed, for upon their size the speed at which the stone is run mainly depends.

The Dangers of Working.

73. The relative position of the stone, the drum, and the pulley varies in different places. In Sheffield the shafting is behind the worker, and in front of the stone there is usually a gangway along which persons constantly pass to and fro during working hours. Before 1895 danger was found to exist from two separate sources involved in this position of the grinding apparatus: there was a considerable liability to injury in putting the belt on to the revolving drum, either in beginning work or after a breakage or after changing the pulley.

The Act of that year made it necessary for all drums to be fenced. This provision has had the double advantage of checking the danger from drums indicated above, and also of preventing the movement of air caused by the spokes of the rapidly revolving drum from acting as a continuous draught on the back of the grinder.

74. The position of the gangway or passage in front of the revolving stones renders a flying stone much more dangerous than it would be if there were a blank wall there; owing to the fact that bursting stones so often fly directly forward the chances of some one being struck are much enhanced. These chances are increased tenfold if there should happen to be, as is frequently the case, a fireplace almost directly opposite the revolving stone.

The position of the stone in relation to the gangway and fireplace has undoubtedly proved a considerable source of danger in the past, and this danger unfortunately remains. The running of a stone "before a fireplace" was prohibited by the Act referred to, but these words have been found too narrow to cover those parts around a fire where the workmen naturally congregate, both to warm themselves after long hours at a sedentary occupation, in which they frequently cannot avoid getting considerably splashed, and to dry their work after it has been ground. Round these words "before a fireplace" some controversy has raged both as to the interpretation to be placed upon the words and as to the necessity for the provision. The former point has been settled after reference to the Secretary of State, whose decision was based upon the legal interpretation of the words. The words thus interpreted do not, in the opinion of the Committee, give that protection to the workmen which is necessary and which was contemplated by the framers of the Act of 1895. They strongly urge that the words in the First Schedule (7.) should be amended. The necessity for the prohibition has, in the judgment of the Committee, been abundantly demonstrated, as may be seen by a reference to the statistics of grindstone accidents in the Appendix.† Between February 1896 and February 1898 eight cases were reported to H.M. Inspector for the Sheffield district, in which fragments of stone flew directly forward, causing serious injury to five grinders; and in April 1898 a fatal accident was reported from this cause. Further, from information supplied by Mr. Johnson, Secretary to the Table Blade Grinders' Society, 15 cases of stones flying directly forward are known. Of these one was a fatal case, and four caused serious injury. Of the remaining nine, in which the stone flew directly forward but caused no personal injury, in several instances the pieces either broke the fireplace or lodged in the hearth. In many of the cases mentioned in the list the direction in which the stone flew cannot now be

* *See* Appendix IX. † *See* Appendix X.

ascertained owing to no particulars having been kept, and to the length of time which has elapsed since their occurrence: thus some of these injuries may have arisen from stones flying forward. Again many cases of stones flying directly forward may have occurred without being reported, since there is no requirement to report except where an injury has been received. In additional support of the contention that the running of grindstones in this position is a source of danger, the Committee had the opportunity of seeing a segment of a stone which had embedded itself in a fireplace during their visit to Sheffield. Since that visit, which took place eight months ago, a man who was at work by the fire was instantaneously killed by a large fragment of a flying grindstone in Pond's Forge Wheel. In this case the fireplace was almost immediately in front of the stone. The Committee would direct attention to a letter* from Mr. F. J. Parkes, Her Majesty's Inspector of Factories, calling attention to this question.

There is no prohibition in the Act of the running of a stone before a gangway, although in new works a stone may not be run before a door or entrance. A recommendation on this point will be found below.

As has been stated, the custom of Sheffield with regard to the position of the machinery is not that of Birmingham. In the latter centre, facing the grinder there is a large thick wall instead of the door, gangway, or fireplace. The pulley is usually closer to the stone, and the drum is sometimes beyond the wall in front of the workman. Stoves are used for heating and for drying the work: they are often at a considerable distance from the worker, behind him and out of line of a possible flying stone.

75. In treating of the dangers of grindstones breaking or flying, as it is more usually termed, it is well to examine the causes which are known to have produced accidents. These are :—

1. Faulty making and re-dressing.
2. Over speeding.
3. Careless using.
4. Inefficient storage.
5. Imperfect hanging.

1.—(*a.*) As has been indicated, the stone may have a flaw in it, which is apparent, and which should have been detected at the quarry. To send out such a stone is an inexcusable act on the part of the quarry owner. At present a common practice prevails by which the quarryman is paid by piece work. This should be prohibited, as failure to obtain payment for a rejected stone offers an inducement to the quarrymen to conceal flaws or defects in the stones.

Without actually having a flaw in it, the whole composition of the stone may be defective. Accidents have not infrequently been due to the excessively soft nature of the stone.

(*b.*) It may have a flaw which is invisible, and is not of sufficient size or importance to affect the cohesion of the whole at first. But when any part of the whole has been worn away by grinding, this flaw may, both by the increased speed at which the smaller stone is run to get an equal surface velocity, and by the fact that the flaw has become of greater relative importance to the remaining mass of the stone, threaten the solidity of the reduced stone, or cause its absolute fracture.

(*c.*) Under this heading the practice of redressing stones should be also grouped. Stones are often returned to the quarry for some flaw or defect which has become noticeable either on delivery, or on "racing," or after it has been in use a certain time when it has been worn down to some extent. If it has been returned as defective, a negligent quarry owner may redress it, and, having disguised the flaw, sell it for uses for which it is unfit, though the flaws of some originally faulty stones may be completely removed; so that the stone, after redressing, becomes perfectly sound for other grinding processes. Again, there are grinders who, in order to get a cheap stone, may be willing to run the risk of using one which has been rejected as defective. It may or may not have been returned to the quarry, and is sometimes purchased by the grinder for immediate use with all its defects.

(*d.*) Another source of accident is found in the severity of the shock which the stone sustains in quarrying by blasting. Explosives should not be allowed in quarries where grindstones to be run by power are made.

(*e.*) When the stone is being fashioned from the block which has been quarried, opinions vary as to whether it should be sawn along the sides or chiselled. Some

* *See* Appendix XI.

maintain that the blow of a hammer on a chisel might set up a crack which by sawing would not be created, whilst others hold that during the process of chiselling any existing flaw would be discovered which would be concealed in sawing.

(*f.*) After the stone is made, care should be taken in the loading and unloading on the trucks. Stones should not be thrown down but should be handled carefully, both in removing them from the truck, and in making the hole for the spindle.

2.—(*a.*) The engine which drives the stone may through some cause run away, and, owing to defective governor gear, fail to be checked.

(*b.*) The pulley which turns the stone may be too small, and thus a greater speed may be imparted to it than it can be run at with safety. The common, though rude, rule in Sheffield is that the pulley should be half the height of the stone. The Committee recognise that great risk is incurred by overspeeding, and they hope that protection will be furnished by the proposal made below, whereby an Inspector will be empowered to order that a stone running at excessive speed should at once be stopped. It is believed that the advantage of this power will be widely recognised.

3. The stone which has been used for wet grinding is sometimes left partly resting in the water while the worker goes away, which causes that part of the stone which rests in the water to become heavier, owing to its saturation, than the other parts: this result is known by the term "a heavy side." It is also sometimes produced by allowing a stone which has been run in water to remain at rest out of the water in one position for several days: the action of gravity upon the water absorbed by the stone while wet would thus cause a heavy side.

4. The same defect is often produced by the careless manner in which the stone is stored. If a stone be left standing in a yard without any protection from the weather, the rain falling on it naturally percolates down until the lower part is much wetter than the upper. Standing in a pool or puddle would act equally injuriously, as the stone absorbs the moisture to a certain extent. There is much conflict of opinion as to the best manner in which stones should be stored, whether at the quarry, in the merchant's yards or stores, and at the works. Some witnesses maintained that stones are the better for being weathered, that they get hardened and better compacted by exposure to cold and heat and damp, and that flaws which would remain hidden until the stone flies are by this means disclosed. But the majority of experienced witnesses took the opposite view, that before use stones should be kept in a covered place, protected from the weather.

Besides the reasons indicated before, the influence of frost must not be left out of account. A porous or soft stone exposed to the weather, having absorbed a certain quantity of water, must in the expansion of that water when solidifying into ice be subjected to a great pressure or stress within itself. It is an undoubted fact, that during every severe frost at Sheffield there occurs an epidemic of grindstone accidents. The explanation is simple, and the fact is sufficient to establish the opinion that grindstones ought not to be exposed to all kinds of weather, but should be carefully stored.

5. When a stone is running with one side heavier than the other, there is great danger of its flying.

The first operation performed by the grinder in hanging his stone, after he has secured it to the spindle by means of plates or wedges, is to "race" it. If one part is heavier than another the speed at which it revolves soon produces an uneven or bumpy motion, and therein lies the danger of fracture. This "racing" has, therefore, to be carefully done. It consists of the application of a steel tool to the sides of the stone while it is slowly revolving, as is done in turning on a lathe, but the surface to be used for grinding is not touched. Where a little too much has been taken off by the grinder the weight is sometimes restored by the addition of a substance which comes off the stone in grinding known as "wheel swarf."

Upon the question as to the advantage of plates or wedges some difference of opinion exists. Wedges are simpler and cheaper, but there is a danger in wedging a stone too tightly, and this is no uncommon feature. This danger may be produced either by driving the wedges in too tightly, or by the swelling of the wood owing to damp after it has been in use some time. By this means a line of cleavage may be produced from the centre towards the circumference, which after a time may induce a crack and a fracture. In the same manner square holes are to be avoided, as they are often filled up by wedges, and cracks are sometimes induced. Plates, on the other hand, neither swell nor contract; and they hold the stone in such a manner, that if a crack be started at the centre it must spread beyond the outer limit of the plate before the stone can fly; but cracks have been frequently known to originate outside the plate

area, and to have been unconnected in their origin with the method of hanging the stone. In the judgment of the Committee there is less liability for cracks to be started with round holes and plates than with square holes and wedges.

76. Grinders have a habit, when the outer surface of a stone becomes too smooth, of cutting teeth in it with a heavy chopper. This must be performed with care, as a heavy side would be easily produced by chopping too much off one part and not enough off another.

Further, it is suggested that a crack might be set up in a stone by hacking it too heavily or by striking it twice in the same spot. This was stated by an experienced witness at an inquiry, held in the sheriff court of Renfrew and Bute at Paisley, into the death of David Ferguson, who was killed by a bursting grindstone on the 27th March 1898. The Committee are indebted to Mr. Archibald Newlands, H.M. Inspector of Factories, for the minutes of evidence in this case.

77. Besides the sources of accident just enumerated, there are certain matters upon which danger to life or limb largely depends, although they cannot affect the question of whether a stone will fly or will remain sound during its whole existence. The "horsing chains" described above may not be strong enough to resist the force of the fragment of flying stone. If this were so, the "horse" and the grinder upon it would be knocked over with such violence as to cause serious if not fatal injury; and it is of great importance that the "horse" itself should be of good and substantial material, and well secured.

78. It is common to find openings in the floor of the landing just outside the hull doors; these are for the purpose of admitting stones hoisted by the lift. A grinder being unaware that such an opening was for the time uncovered, runs great risk of falling through, should he open the door at this moment. Hoists for grindstones are generally, however, outside the building, but often situated just above the entrance on the ground floor; the breakage of the hoisting chain or the slings holding the stone might cause it to fall upon anyone entering the hull.

General Remarks.

79. In enumerating the dangers of flying grindstones indications have been given of certain ways in which some of the dangers might be avoided by (1) taking more effective steps to insure the soundness of the stone; (2) running the stones in such a manner as to avoid all unnecessary risks of their becoming faulty; and (3) so placing stones that the workers shall not be exposed to any preventable risk. In this connection two matters have come within the cognizance of the Committee, which should be stated. The first of these relates to the testing of grindstones, the second to the powers of an Inspector.

Testing of Grindstones.

80. In some places, notably Redditch, stones are subjected to a test by being run for an hour or so at a higher speed than will be required when in use. Where the precaution of testing is adopted it is carried out in a machine which, in the event of any fracture of the stone, would prevent the fragments from flying into the air or hitting any person. In Sheffield actual testing in a place other than that in which it is proposed eventually to use the stone is unknown; but after the process of "racing" it is usual to allow the stone to run for 20 minutes to half an hour in the "trow" in which it is designed to run afterwards. In considering the advisability of recommending that general testing shall be required, the Committee have had the difficulties of enforcing such a rule borne in upon them with convincing force. The conditions under which this trade is carried on at Redditch are exceptional, as the men are employed in large factories by an occupier who supplies the stones, which are nearly all of one size and are run dry. In Sheffield grinders, like file cutters, are not generally employed by an occupier of a factory, but rent a "trow" or grinding place where power is let out, and they are paid according to the amount they perform. It would be difficult, if not unfair, to expect a grinder to hang a stone and run it for an hour or more in a place where he cannot utilise it for work, and then have to remove it to his own "trow" for use. Further, an Inspector would have to supervise the testing

of every new stone, both at the quarry and at the factory, before it was hung. Moreover, the evidence on this point was conflicting; some Sheffield witnesses agreed that the Redditch system of testing, if applied to the Sheffield system of running, might develop or even create flaws which would not be disclosed in the test. The Committee, therefore, do not consider it practicable or advisable that the Redditch system* should be universally required, though they are pleased to be able to record its local success, but they are of opinion that a stone should be run for half an hour in the "trow" in which it is meant eventually to be used, and that this test should be conducted in such a manner as to be free from risk to the workers. This is secured in a large Birmingham factory by the abstention from work of the man on each side during the test. Thus a clear space of 10 feet on each side is obtained. Finally, the Committee would refer to the annual report for 1896, of Mr. Dodgson, H.M. Inspector of Factories, an extract from which will be found in the Appendix.†

The Powers of an Inspector.

81. In cases where danger is anticipated, either from the nature of the stone or from the speed at which it is run, an Inspector should, in the judgment of the Committee, have power to stop at once the running of such stone, and from time to time application is made to him to do so. Section 4 of the Act of 1895, although designed to meet such a danger, has not been available in this case, owing to the belief that a grindstone is not a machine, and owing to the delay which of necessity must occur between the application to the Inspector and the judgment of the court.

Health.

82. Any inquiry into the cutlery trade a few years ago would have turned largely upon the serious illness and mortality from lung disease, caused by the inhalation of steel and stone dust in dry grinding. It is satisfactory to be able to report that the danger from this source has been largely mitigated by the use of fans, and that many of the difficulties which formerly attended the application of Section 36 of the Act of 1878 have been removed by Section 24 (*e*) of the Act of 1895. This amending section, which places upon the owner the responsibility of supplying "the pipes or other contrivances necessary for working the fan" has produced beneficial results. They again refer to Mr. Dodgson's report in confirmation of this view. The other dangers to the health of the workpeople are those engendered by a sedentary occupation, conducted in places which are generally dirty, damp, and draughty, and often so dark as to compel the exclusive use of artificial light.

Section 33 of the Act of 1878, which requires periodical lime-washing, has been evaded in grinding hulls in consequence of a special exception granted to works in which there are no glazed windows. In some hulls there never have been windows; in others all the glass has been broken and never replaced. In the opinion of the Committee cleanliness would to some extent be secured by periodical lime-washing; this can now be required in those grinding hulls in which there are glazed windows. An objection has been raised by the grinders that whitewash causes a light which interferes with the work, but it should be understood that limewashing is not of necessity "whitewash." This is recognised in all burnishing rooms in electro-plate works; the lime used for these rooms is darkened before application.

83. The following suggestions have been submitted to the Committee, but as there has not been sufficient evidence in their support, the Committee do not feel justified in including them among their recommendations, though they wish to make reference to them :—

(*a.*) That a smoke test would disclose certain cracks not discoverable by other tests.

(*b.*) That all holes should be round, as cracks are more likely to be developed by square holes.

(*c.*) That stones should be "raced" to the "eye." This is suggested in the belief that more cracks would be discovered if it were the practice to "race" the stone over the whole of its side from circumference to centre. The existing custom is to race it only for a short distance from the circumference.

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* *See* descriptions and illustrations of testing in Appendix XII.

† *See* Appendix XIII.

84. The Committee have considered the desirability of requiring that all grindstones should bear upon them the name and address of the maker, but the difficulty of securing permanency of the mark without impairing the strength of the stone has prevented their adopting this recommendation.

85. It has also been suggested that no "horsing chains" should be used which have not been certified as having withstood the Government test, but in view of the fact that a "trow" with all its apparatus, including "horsing chains," passes through many changes of proprietorship in a comparatively short space of time, the Committee fear, that, owing to the difficulty of enforcement, it would not be practical to make this requirement.

86. The Committee desire to recognise the valuable assistance rendered by Mr. S. H. Knyvett, H.M. Inspector of Factories, during their inquiries in Birmingham; and to his colleague Major Roe they are also indebted for information which will be embodied in their next Report.

RECOMMENDATIONS.

87. The Committee venture to make the following recommendations, which are intended to apply to grindstones which are run by power:—

(i.) In the getting of stone for the manufacture of grindstones, no dynamite, blasting powder, or other explosive, should be employed. Where other classes of stones are also prepared in the same quarry no explosive should be used within 30 feet of the workings where stone to be made into grindstones is obtained.

(ii.) All persons engaged in the manufacture of grindstones should be paid for the time spent upon the work, irrespective of whether the stone is discovered to be defective or not.

(iii.) It should be an offence for any person to sell a stone which has been redressed without stating this fact to the purchaser.

(iv.) Stones, when complete, whether at the quarry, in the merchant's yard or in the factory, should be stored in such a manner as to be protected from rain, snow, or hail; and measures should be taken to prevent the part which touches the ground from resting in water or on damp soil.

*(v.) In all grinding hulls constructed after August 1st, 1899, no hoist or teagle should be placed immediately above a main entrance or a doorway to any hull or room.

*(vi.) All openings in floors for the passage of stones during hoisting into the hulls should be so constructed that the trap-door will close automatically when the stone has passed through.

*(vii.) All entrances adjoining such openings should be provided with chains or bars, with which they should be protected during the operation of hoisting.

(viii.) No grindstone of a greater diameter than eighteen inches should be hung with wedges.

(ix.) Grindstones, whether at their first running or upon change of proprietorship, if they be more than thirty inches in diameter, should be run in the "trow" or stonehole for a period of half an hour before the grinder gets on to his "horsing" at a speed not less than that at which they are intended to be run when in use. It should be made an offence for any person to stand near or in front of the stone being tested, and a prescribed signal should be employed to indicate that the test is being carried on.

(x.) No stone should be allowed to rest in water during the night, or during any cessation from work of greater duration than ten hours.

(xi.) Where wet stones rest for one or more days they should be half turned round daily.

(xii.) A register should be provided by the occupier, who should enter in it the date of the testing of every stone. Where there is more than one occupier the owner should provide the register, which should be left in charge of his engine tenter or caretaker.

*(xiii.) The following regulations should be applied to fireplaces:—

(*a*.) No grindstone should be run before any fireplace. The proscribed area should be that within two parallel straight lines drawn at right

* The owner should be responsible for the execution of these duties.

angles to the wall containing the fireplace at a distance of three feet upon either side measured from the centre point of the fireplace.

(*b.*) Where the fireplace is situated in a corner formed by the junction of two walls, the proscribed area should be that contained within one of the walls, and a straight line drawn parallel to it at a distance of $3\frac{1}{2}$ feet from it.

(*c.*) Where the stone revolves upon an axis at right angles or approximately so to the wall in which the fireplace is situate, the proscribed area should be that contained within this wall and a straight line drawn parallel to it at a distance of three feet from it.

*(xiv.) In all grinding hulls erected after the first day of August 1899 no stone should be run before any gangway or passage.

*(xv.) All grinding hulls should be limewashed not less than once in every fourteen months.

*(xvi.) All passages and staircases leading to grinding hulls or rooms should be effectively lighted. Where there is more than one occupier this should be the duty of the owner.

(xvii.) No engine tenter should be employed in any manner which would prevent him from exercising proper supervision and control over the engine while it is running without having previously placed it in the charge of some competent person.

(xviii.) Where an Inspector is satisfied that any grindstone is in itself defective, or by reason of the method in which it is hung, or the speed at which it is run, that it is likely to cause injury to any person, he should have power by an order in writing to direct that such stone shall at once be stopped, and that it shall not again be run until he is satisfied that it can be run with safety. Any occupier or any owner or hirer of a grindstone receiving such notice should be empowered to make a written requirement that the Inspector shall take the earliest opportunity of stating his case before a court of summary jurisdiction, in order that such court may cancel or confirm the order.

(xix.) Where it is asserted by the purchaser that a stone delivered at the works is in itself so defective that the running of such stone is likely to cause injury to any person, an Inspector should have power to decide, with the help of expert evidence, whether such stone should be hung or not; and where he is satisfied that the stone is so defective, the seller should remove it at his own expense. The seller should be empowered to make a written requirement that the Inspector shall take the earliest opportunity of stating his case before a court of summary jurisdiction, in order that such court may cancel or confirm the decision.

(xx.) The bursting or flying of all grindstones should be immediately reported to the Inspector for the district by the occupier of the factory. Where there is more than one occupier this should be the duty of the hirer or the owner of the grindstone.

TESTING OF BOTTLES BY COMPRESSED AIR.

88. After annealing, and before packing for delivery to customers, a wise system is adopted by many glass bottle manufacturers of testing the bottles by the admission of compressed air. In the works visited by the Committee a certain number of bottles in each "heat" were tested at a pressure of 150 lbs.

Any mistake during the process of annealing, or accidental contact whilst removing from the furnaces, might render the bottles liable to "fly" when filled, and it is to discover these flaws or defects that testing has been adopted. The process consists of the admission into the bottle of compressed air by means of suitable pipes and machines very similar to the machines used for bottling aerated waters. This system is much to be commended, giving, as it does, a measure of security to persons

* The owner should be responsible for the execution of these duties.

engaged in any of the hazardous processes connected with bottling aerated or highly fermented beverages. In the interests also of consumers such a measure of security is much to be desired.

But it is necessary that the workers engaged in this process should be protected. In most works masks or wire gauze veils and gauntlets are provided, and the bottle is properly guarded as in "bottling machines" for aerated waters, but as such precautions are not universal, in the opinion of the Committee it is desirable that legal powers should be given to Her Majesty's Inspectors to require their adoption and use.

This process was added to those scheduled for inquiry in consequence of the loss of an eye by a girl engaged in testing, who unhappily had neglected to wear the face screen provided for her use.

"ENDING AND MENDING" IN VELVET WORKS.

89. This trade was, after the formation of the Committee, added to their reference for inquiry owing to a complaint received by the Committee that certain girls occupied in this work at Manchester had suffered injuries to their health. It was alleged that certain poisonous vapours, from mixing dyes in a lower part of the building, had penetrated through the floor to the room in which the girls were engaged in mending holes produced in cotton velvets by a previous process. The repairing of these damages is called "ending and mending," and the mixing of dyes which was being carried on had no necessary connection with that process. Upon local inquiry into this complaint no specifically noxious fumes could be traced, although unpleasant odours are inseparable from the preparation of vegetable dyes. The employer, when the grievance was submitted to him, removed the objectionable process from beneath the room in which the girls were employed. Further inquiry disclosed no sickness or injury to health among the workers, and as the "ending and mending" process is one which of itself is a perfectly healthy occupation, when conducted under ordinary and sanitary conditions, the Committee have requested and obtained the permission of the Secretary of State to have this trade withdrawn from their reference.

H. J. TENNANT.
MAY TENNANT.
THOMAS OLIVER, M.D.
HAMILTON P. SMITH.

28th August, 1898.

APPENDIX I.

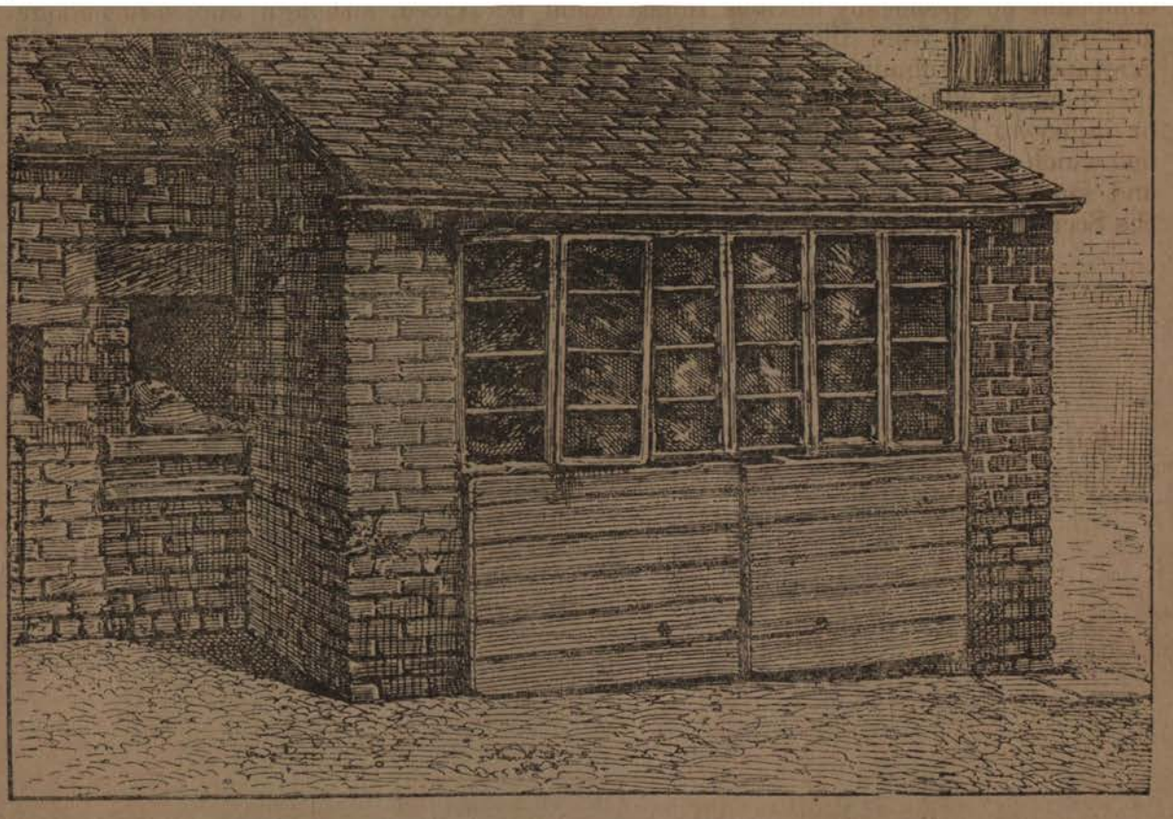
File Cutters' Pewter Beds from Rainhill.

The two samples forwarded were entirely different. One showed a small granular crystalline fracture, and was marked "P"; the other consisted of large flaky crystals. The former contained 9·41 per cent. of lead, and the latter 1·24 per cent. of that metal.

APPENDIX II (*a.*)

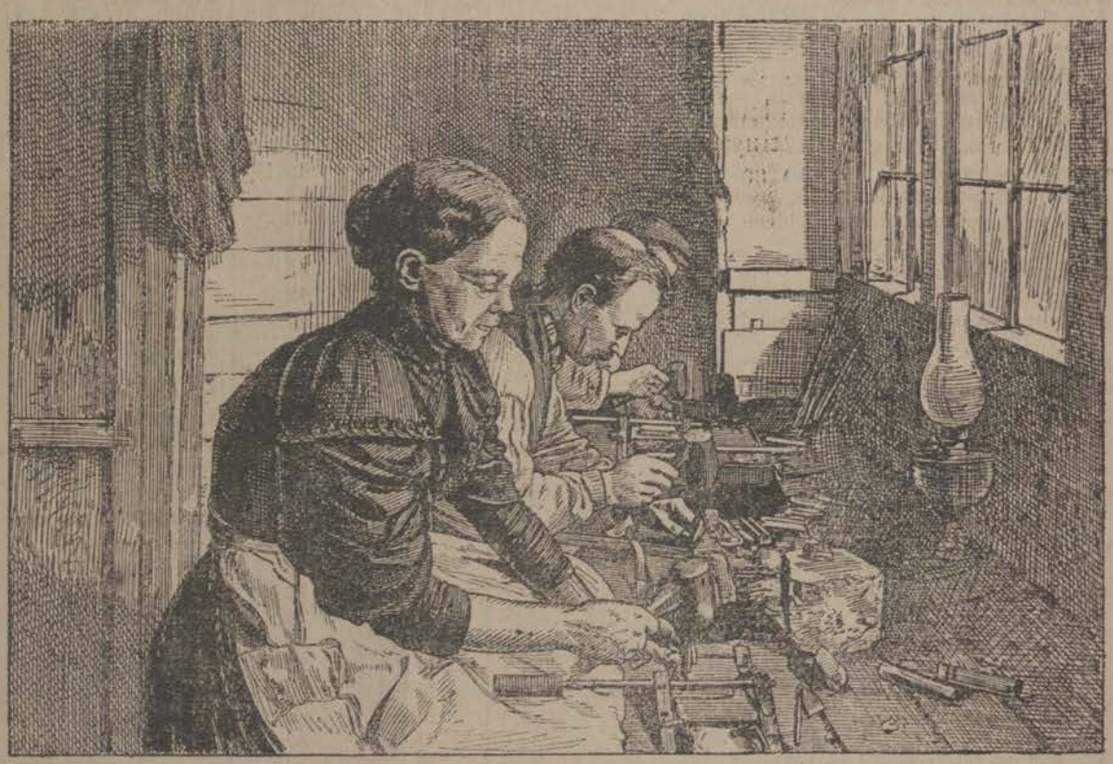
The subjoined woodcut is taken from a photograph of a typical file cutters' "shop" in a Sheffield court. It contains four "stocks." The smaller outhouse on the left is a privy midden, used by the workers and by the inhabitants of the houses in the court. The door of the cutting "shop" is not shown in the picture, but it is on the right, and that of the privy midden is on the left-hand side.

In the Rainhill file cutting district offensive cesspools were often found quite close to the work place. The sanitary conditions there are as bad, if not worse, than in Sheffield.



APPENDIX II (*b.*)

This Woodcut represents the INTERIOR of a TYPICAL FILE CUTTING "SHOP" in SHEFFIELD.



APPENDIX III.

TABLE I.

DEATHS in SHEFFIELD from LEAD POISONING for Period of Twelve Years, 1885–96, supplied by DR. LITTLEJOHN, formerly Medical Officer of Health for Sheffield.

Cause of Death.	Sex.	Age.	Occupation.
1885:—			
Plumbism, lead colic	M.	36	File cutter.
Lead colic, plumbism, epilepsy	M.	22	Cutler.
Plumbism, apoplexy, asphyxia	F.	51	General servant.
Plumbism, Bright's disease	M.	32	File cutter.
1886:—			
Plumbism, pneumonia	M.	51	Brass turner.
Plumbism, convulsions, paralysis	M.	37	File cutter.
Lead colic, cardiac, drinking Redmires water	M.	75	Builder.
Lead poisoning, syncope, drinking Redmires water	M.	42	Book-keeper.
Plumbism, bronchitis	M.	42	File cutter.
Plumbism, apoplexy, lead colic, epileptic fits	M.	41	„
Lead colic, epileptic fits, plumbism	M.	39	„
Lead poisoning, paralysis	M.	25	„
Lead palsy, plumbism	M.	35	„
Chronic lead poisoning	M.	42	„
Chronic lead poisoning, plumbism	M.	46	„
1887:—			
Plumbism, paralysis	F.	22	Lead worker.
Plumbism, pneumonia	F.	29	Unknown.
Lead poisoning, colic	M.	42	File cutter.
1888:—			
Cardiac disease, plumbism	F.	57	Wife of accountant.
Plumbism	F.	19	Lead carrier.
Lead poisoning, epilepsy	M.	45	File cutter.
Plumbism, albumenuria	M.	12	Son of joiner.
Plumbism, epileptic fit	M.	24	File cutter.
Plumbism, broncho-pneumonia	M.	66	Razor grinder.
Plumbism	M.	37	Plumber.
Lead poisoning, chronic kidney disease, uraemia	M.	39	Cutler.
Asthenia, plumbism	M.	64	File cutter.
Plumbism	M.	37	„
Lead poisoning, effusion on brain	M.	53	„
Chronic plumbism, apoplexy	M.	57	„
Plumbism, uraemia	M.	48	„
Plumbism, morbus cordis	F.	24	Unknown.
Epileptiform convulsions, lead poisoning	M.	27	Labourer.
Chronic plumbism	M.	49	Saw maker.
1889:—			
Plumbism, chronic Bright's disease	M.	39	File cutter.
Lead poisoning, painter's cholic, asthenia	M.	37	Painter.
Plumbism, bronchitis, exhaustion	M.	52	File cutter.
Plumbism	F.	21	No occupation.
Plumbism	M.	45	File cutter.
Lead colic, liver disease	M.	49	„
Plumbism, syncope	M.	51	Painter.
Bright's disease, plumbism	M.	25	File cutter.
Chronic nephritis, plumbism	M.	42	„
1890:—			
Lead poisoning, Bright's disease	F.	38	Lead mill hand.
Plumbism, albumenuria	F.	39	Wife of grinder.
Plumbism, epilepsy	F.	16	Daughter of porter.
Plumbism, nephritis	M.	56	File cutter.
Plumbism, disease of kidneys	M.	39	„
Lead poisoning	M.	53	„
Plumbism, paralysis	F.	50	Wife of policeman.

TABLE I.—*continued.*

Cause of Death.	Sex.	Age.	Occupation.
1891:—			
Plumbism, Bright's disease	M.	60	File cutter.
Lead poisoning	F.	46	Lead worker.
Plumbism, morbus cordis, convulsions	M.	49	File cutter.
Plumbism, anæmia, syncope	F.	35	„
Lead poisoning, epileptiform, convulsions	F.	24	Lead worker.
Lead poisoning, convulsions, coma	F.	40	Unknown.
Plumbism, apoplexy	M.	46	File cutter.
Lead poisoning, rheumatism, dropsy	M.	43	„
Chronic lead poisoning	M.	30	?
Lead poisoning, kidney disease	M.	44	File cutter.
1892:—			
Chronic plumbism, pneumonia	M.	50	File cutter.
Plumbism	M.	43	Table-knife hafter.
Plumbism, apoplexy	M.	39	File cutter.
Plumbism, uraemia	M.	64	„
Lead poisoning, Bright's disease	M.	46	„
Paralysis, plumbism	M.	45	Lead mill worker.
Epilepsy through lead poisoning	F.	18	„
Lead poisoning	M.	34	File cutter.
1893:—			
Plumbism, Bright's disease	M.	33	File cutter.
Plumbism, chronic nephritis, uraemia	F.	43	„
Plumbism, nephritis	M.	52	Metal smith.
Plumbism, chronic Bright's disease, uraemia	M.	33	File cutter.
Plumbism, purpura hæmorrhage	M.	38	File hardener.
Plumbism, morbus cordis, dropsy	M.	34	File cutter.
1894:—			
Plumbism, epilepsy, convulsions	M.	30	Table-knife hafter.
Lead poisoning, softening of brain	M.	61	File cutter.
Plumbism, cerebral disease	M.	34	„
Plumbism	M.	46	„
Lead colic, syncope	M.	52	„
Plumbism, cerebral atrophy	F.	32	„
Plumbism, paralysis	M.	41	File cutter.
Plumbism, lead poisoning, rheumatic fever	M.	47	Plumber.
Plumbism, phthisis	M.	35	File cutter.
1895:—			
Lead poisoning	M.	50	File cutter.
Lead poisoning, ascitis	M.	31	„
Plumbism	M.	52	„
Plumbism, morbus cordis	M.	47	„
Plumbism, enteritis, exhaustion	M.	53	„
1896:—			
Plumbism, paralysis	M.	22	File cutter.
Plumbism, asthenia	M.	49	„
Plumbism, epilepsy	M.	32	„ (machine).

TABLE II.

SHOWING the NUMBER of DEATHS and the DEATH RATES amongst FILE-CUTTERS (Males) from various Causes during Twelve Years, 1885–1896, and the DEATH RATE amongst the GENERAL POPULATION (Males over 15 years of age) of SHEFFIELD during the same Period and from the same Causes.

Diseases.	File-Cutters.		Death Rate per 1,000 of General Population of Sheffield (Males above 15 years), 1885–1896.	Death Rate amongst File-Cutters expressed as Percentage of Death Rate amongst General Population. (Males.)
	Total Deaths 12 years, 1885–1896.	Death Rate per 1,000.		
Nervous System	161	2·97	1·96	151
Respiratory System	245	4·52	4·72	96
Phthisis	194	3·60	3·01	119
Urinary System	86	1·59	·74	214
Circulatory System	105	1·93	1·94	99
Digestive System	21	·38	·46	82
Diseases of Liver	16	·29	·41	70
Other Causes	238	4·39	4·54	96
All Causes	1,065	19·68	17·83	110

TABLE III.

TOTAL NUMBER of CASES of LEAD POISONING treated at the Sheffield General Infirmary during 1894 and 1895.

Males	30
Females	4
Total	34
Occupation:—	
File cutters	25
Rasp cutter	1
Painters	3
Cases due to water	5
Total	34

TABLE IV.

LEAD POISONING CASES due to FILE CUTTING, reported to Her Majesty's Superintending Inspector of Factories during 1896, 1897, and January to June 1898.

1896	18
1897	38
1898 (January to June)	18
Total	74

W. DAWKINS CRAMP.

35, Paradise Street,
Birmingham,
12th July 1898.

NOTE.—These figures relate exclusively to the Midland division of England. The law which requires all cases of lead poisoning in factories and workshops to be reported only came into force on 1st January 1896. It is still but imperfectly understood, though vigorous steps are being taken to inform those concerned of this obligation.

APPENDIX IV.

ANALYSIS of SCUM from the SURFACE of the ZINC BATH in GALVANIZING WORKS.

The analysis showed:—

Zinc chloride.
Ammonium chloride.
Including ·15 per cent. of lead.
Free from arsenic.

ANALYSIS of FUMES from GALVANIZING BATHS.

(Taken from a position about one foot above the surface of the Molten Zinc.)

—	Sample I.*	Sample II.
	Gram.	Gram.
Ammonium chloride - -	·0092	·0024
Zinc chloride - -	·0143	·0079
Ammonia - -	·0318	·0032
Total -	·0553	·0135

* Minute traces of arsenic were discoverable in this sample, but Dr. Thorpe adds, "the quantity was far too small to have any injurious consequence."

APPENDIX V.

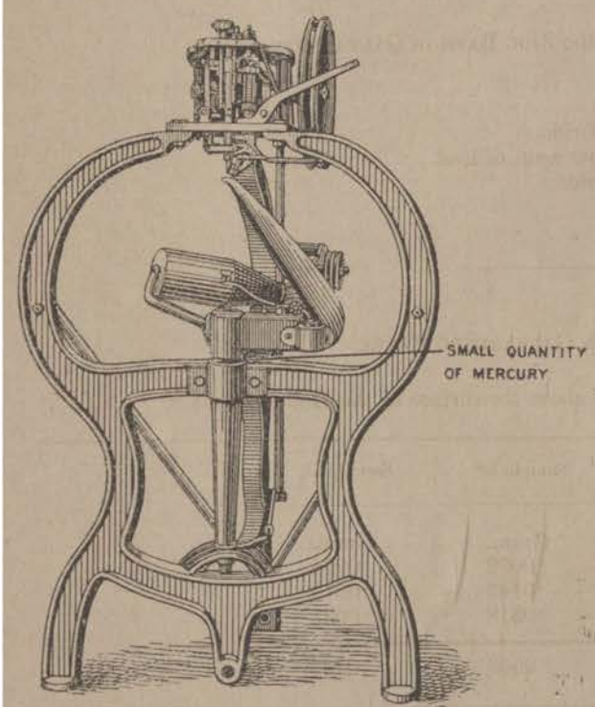


Figure 1.
Blake Sole-Stitching Machine.

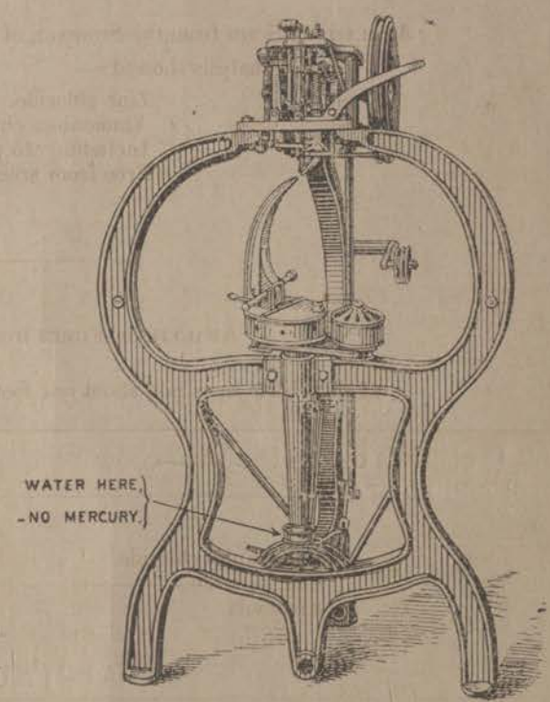


Figure 3.
Blake Sole-Stitching Machine with new Stanley Horn.

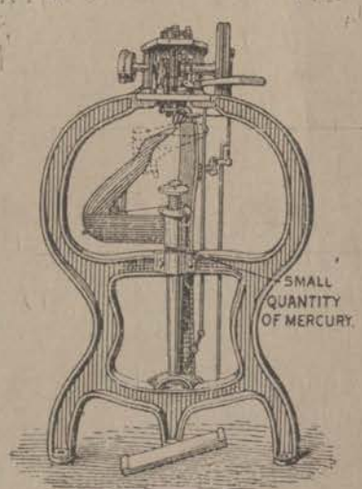


Figure 2.
Blake Sole-Stitching Machine,
showing position of boot on the horn.

APPENDIX VI.

TABLE I.

ANALYSES of TWO SAMPLES of "PUTTY POWDER."

—	Sample I.	Sample II.
	Per cent.	Per cent.
Oxide of tin - -	29·72	28·96
Oxide of lead - -	70·28	68·07

TABLE II.

ANALYSIS of Messrs. JOHNSON, MATTHEY & Co.'s new "PUTTY POWDER."

"It consists of oxide of tin containing but traces of lead (0·02 per cent. as oxide of lead) and no arsenic."

APPENDIX VII.

ANALYSIS OF ROUGE.

Two samples were sent, both consisting of commercial oxide of iron.

In the one case there was found 0·13 per cent. of arsenious acid, and in the other only a trace.

APPENDIX VIII.

The following are some of the methods of automatically locking a vessel moved by hydraulic power should there be a breakdown of the pressure or any failure in the machinery.

1. A valve off its seating while the pressure is on, but should the pressure fail a spiral spring closes the valve and prevents the return flow of the water and locks the converter.

The subjoined drawing of a safety valve put in by Messrs. J. G. Bartlett & Co. illustrates this principle.

2. A spiral spring contained in a cylinder is in compression when the pressure is on, and a valve is off, its seating. If the pressure fails, the spring acts and forces a kind of piston rod forward. The end of this rod is bent and fitted in such a way that it wedges the cogs on the side of the converter which work in the ratchet bar, and thus the converter is locked.

3. The trunnions are extended beyond the cogged wheel and ratchet; on the extended part is fitted a steel grooved drum with brake blocks applied. The brakes are in connexion with levers which work when the pressure fails. This allows a weight to descend which applies a pressure of 60 tons to each of the two brake blocks. There are locking valves connected to the extremity of the brake lever, locking the water in the cylinder as soon as the lever begins to work.

4. Messrs. Steel, Peech, and Tozer, of the Ickles, Rotherham, have recently adopted an efficient automatic safety valve; they forwarded to the Inspector for the district a carefully prepared drawing and explanation, of which they very kindly authorise him to make any use he pleases. The drawing is unfortunately too large for insertion in this Report, but the Committee will be pleased to show it to any manufacturer interested in the subject.

5. Another form of converter was seen by the Committee at Messrs. Nettlefold's works near Newport, Monmouthshire. This, although fitted with no automatic safety apparatus, was so constructed that, in the event of a failure of the pressure, the spilling of the molten vessel would not be possible. This is owing to the converter being provided with a weighted bottom by reason of which it would of necessity revert to an upright position when the pressure is removed.

The Committee think the subjoined extracts from a letter from Mr. J. W. Graham, engineer to the Frodingham Iron and Steel Works, near Doncaster, may be of interest.

"The valve in question has always acted all right when tried. We have never had any accident whereby it could be tried, but every fortnight we try it by suddenly stopping the pressure pumps, and the ram always remains stationary in position where it was when pumps were stopped."

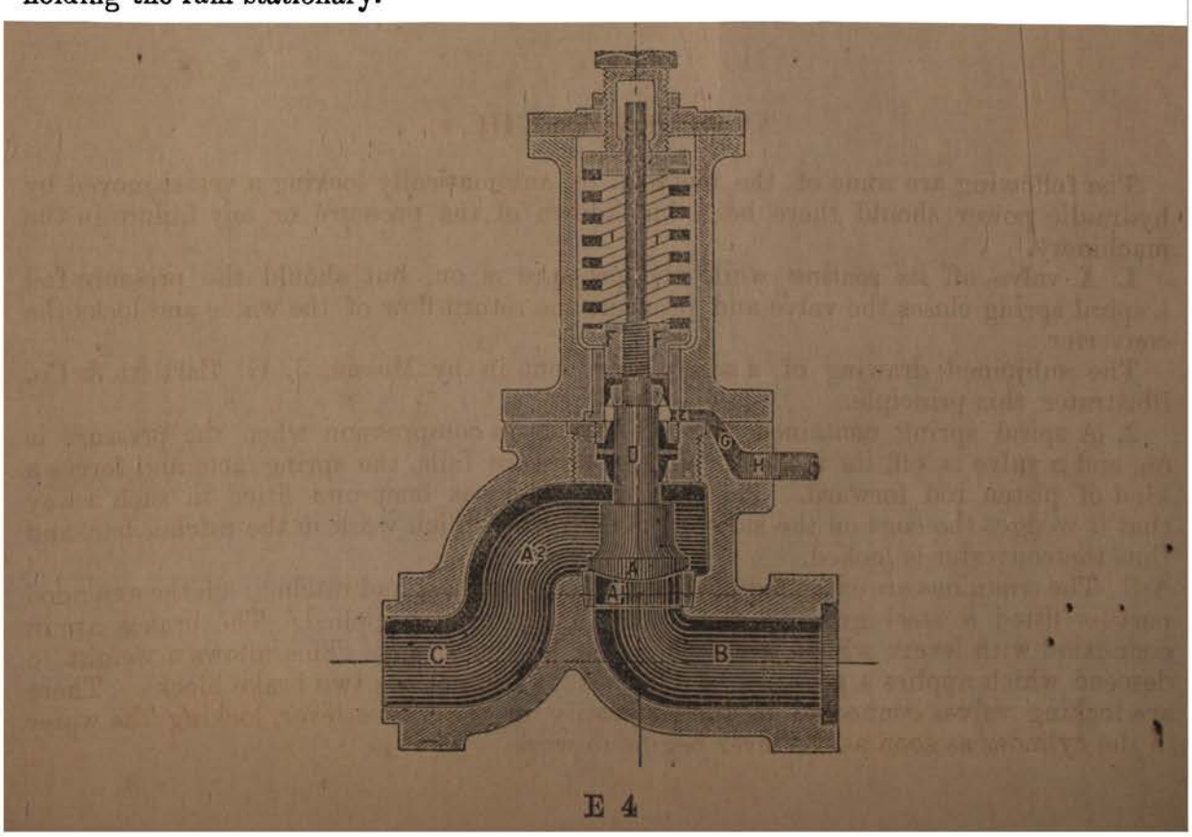
This statement was made in relation to a safety valve fitted to a casting crane.

The figures shown in the appended drawing represents a vertical section of an automatic hydraulic safety valve constructed and arranged in accordance with this invention, for use in connection with hydraulic cranes, hoists, lifts, and the like.

The valve consists of a disc A having a seat A^1. The valve chamber A^2 communicates by the throat B with the working valves by which the water is admitted to and exhausted from the ram.

By the throat C the chamber A^2 communicates with the ram. Extending upwards from the valve disc A is a spindle D which passes through a stuffing box in a cylindrical chamber E in which is a piston F carried on the said spindle D. At the bottom of the cylinder is an orifice G leading to a pipe H communicating with the hydraulic main.

Above the piston F and between it and the underside of the cover of the cylinder E is a spiral spring I coiled round the spindle D. When the stop valve which governs the water supply from the accumulator is opened the water enters the cylinder E by the orifice G, the piston F is forced upwards compressing the spring I, and the valve A is raised to permit the flow of water from the working valves to the ram. In event of failure in the pressure of water through the fracture of the main pressure pipe or other cause the piston F descends and the check valve A is immediately forced down on to its seat by the action of the spring I. Thus the water returning from the ram is prevented from escaping, and, acting above the valve, keeps it firmly closed holding the ram stationary.



E 4

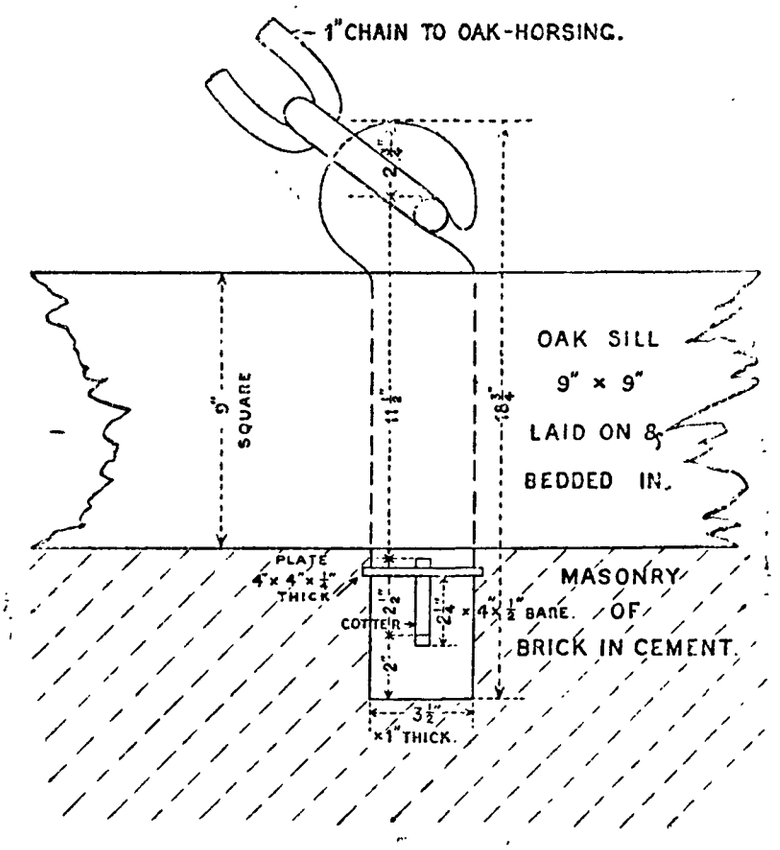
APPENDIX IX.

Sketch of Plan adopted for Fixing the Horsing Chains at the Works of Messrs. A. W. Wills and Son, Park Mills, Birmingham.

One end of the chain is attached by a hook to the end of the bar embracing the upper side of the horsing. The strength of this bar and of the chain is the same.

The other end of the chain is caught by an iron hook $18\frac{3}{4}$" in length, and of greater strength than the bar and chain, being about $3\frac{1}{2}$" in thickness.

All but 4" of this hook is sunk, first through the oak sill at the side of the trough, and then into the masonry below, being finally held down in case of jerk by a transverse pin running through a slot in the shank of the hook, the pin extending laterally into the masonry.



APPENDIX X.

STATISTICS RELATING TO GRINDSTONE ACCIDENTS IN SHEFFIELD.

List of Fatal Accidents through Breakage of Grindstones in Sheffield, compiled from the Records of Her Majesty's Coroner.

Date of Accident.	Name and Address of Firm.	Name of Person Killed.	Verdict of Jury, or any Recommendations.
3 December 1884 -	Lockwood Bros., Arundel Street.	Chas. B. Hawes -	From injuries received by the accidental breaking of a grindstone.
4 May 1885 - -	Wm. Briggs, Woodbourne Road.	William Cope -	From injuries received by the accidental breaking of a grindstone; and the jurors hereby say that the horsing and chains were deficient and out of repair, and that Mr. Briggs, the owner, was highly censurable for neglect.
16 May 1888 - -	Bartram's Comb Works, Sheffield.	John Nolan - -	Accidentally killed by breaking of a grindstone.
8 April 1889 - -	Turner, Naylor, and Marples, Sheffield.	John Thompson -	Accidentally killed by the breaking of a grindstone.
28 August 1889 -	Osborn & Co., Brook Hill.	Saml. Hallam -	From injuries received by accidental breaking of a grindstone on which he was working.
8 November 1889 -	Biggin and Son, Penistone Road.	James Baines -	From injuries received by accidental breaking of a stone on which he was working.
25 February 1890 -	Staniforth & Co., Hackenthorpe.	Amos Cowley - -	From injuries received by accidental breaking of a grindstone. Deceased was on his stone, and the breakage was caused by his running it faster than he should have done, although he was before advised by a fellow-grinder not to put so small a pulley on the axle.
1891 -	Howell & Co., Sheffield.	Chas. Johnson -	Breaking of grindstone on which he was working.
8 February 1893 -	C. Gray and Sons, Sheffield.	C. Rollinson - -	Engine ran away—defective "governors."
„ „ -	Kaiser, Ellison & Co., Sheffield.	Fred. W. Brameld -	Purely accidentally.
5 December 1894 -	Jos. Rodgers and Sons, Norfolk Street, Sheffield.	George Ward - -	Accidentally killed by breakage of a grindstone, but as to cause of stone breaking there is not sufficient evidence to show. The jurors further say that the putting on of bands immediately engine is started is dangerous and ought to be avoided.
*14 June 1894 - -	- - -	William Hill - -	A butcher's-blade grinder was entering a grinding-hull at the Soho Wheel, when pieces of a stone flew straight forward, breaking his skull.
*9 April 1898 - -	G. Senior and Sons, Pond's Forge Wheel, Sheffield.	Ezra Ronksley, age 33	Whittening stone broke. Fragment struck Ronksley in face, as he sat by the fire, fatally injuring him.

* In these cases the stone flew directly forward.

THE FOLLOWING ACCIDENTS HAVE BEEN REPORTED TO HER MAJESTY'S INSPECTOR SINCE FEBRUARY 11, 1896; THEY, HOWEVER, IN NO WAY REPRESENT THE NUMBER OF STONES THAT HAVE FLOWN, AS THE ONLY ACCIDENTS REQUIRED BY LAW TO BE REPORTED ARE THOSE WHERE ANY PERSON IS KILLED OR INJURED.

Date of Accident.	Firm.	Name of Injured Person.	Injury and Attendant Circumstances.
21 February 1896 -	Mappin and Webb, Sheffield.	John Baker - -	Struck on forehead by bolster-stone; horsing defective.
22 April 1896 - -	Burgon and Ball, Sheffield.	Robt. Wood - -	Struck on side.
23 April 1896 - -	John Saxton, Headford Street.	No one hurt.	
26 June 1896 - -	Lockwood Bros., Spital Hill.	Workman - -	Hurt by flying fragment of stone.
9 September 1896 -	Jos. Blackwell, Trafalgar Wheel.	„ - -	Injured.
12 September 1896 -	M. Hunter and Sons, Sheffield.	Aleck Wragg -	Killed by injuries received from flying stone.
29 October 1896 -	Mappin Bros., Baker's Hill.	Jos. Langhorne -	Forehead cut by flying fragment of stone.
30 October 1896 -	Lockwood Bros., Spital Hill.	Workman - -	Slightly hurt.
25 November 1896 -	Tyzack, Sons, & Co., Sheffield.	„ - -	Injured.
*8 December 1896 -	Ibbotson's Wheel, Cambridge Street.	Edwin Parkin -	Standing by the hearth, had his leg broken by flying stone.
9 December 1896 -	Geo. Fisher & Co., Hoyle Street.	No one hurt.	
* „ „ -	Thos. Ellin's Wheel, Sheffield.	„ „ - -	Large piece of stone went straight forward through doorway and into a cottage across the yard.
23 December 1896 -	Ramsbottom, St. Philip's Road.	Workman - -	Arm cut. Stone breaking loose from bearings.
18 January 1897 -	Ramsbottom, St. Philip's Road.	Young man - -	Injured on head.
9 February 1897 -	Garfitt and Son, Cross Scythes Works.	Workman - -	Slightly hurt.
13 February 1897 -	T. Firth and Sons, Sheffield.	A. Hindle, A. Jordan	Stone broke whilst racing. Both men injured.
„ „ -	Brookes and Cooper, Mousehole Forge.	George Guite -	Seriously hurt.
11 March 1897 - -	Newbould & Co., Newhall Works.	Arthur Crookes -	Injured.
„ „ - -	Moseley, Portland Works.	Joseph Hill - -	Struck in face.
19 March 1897 -	Skelton & Co., Sheffield.	Harold Deakin -	Injured by piece of flying stone whilst racing.
30 April 1897 - -	Moss and Gamble, Sheffield.	Workman - -	Shaken, but not seriously hurt.
25 February 1897 -	M. Eadon and Sons, Sheffield.	Geo. Sharp - -	Face cut and arm sprained.
*25 May 1897 - -	Hartley and Sons, Daisy Walk.	E. Middleton - -	Doing work which necessitated his being in front of fireplace. Struck in back.
16 July 1897 - -	Beardshaw and Sons, Sheffield.	Jos. Forrest - -	Shoulder bruised, and shock to system.
27 August 1897 -	Ward and Payne, Sheffield.	Percy Gill - -	Injured.
9 September 1897 -	Moseley & Co., Sheffield.	G. Redfearn, 56 -	Right leg bruised. Stone very unsound.
„ „ -	Moseley & Co., Portland Works.	A. Hobson - -	Foot and calf of left leg bruised.
25 October 1897 -	H. Porter, Pearl Handle Manufacturer, Sheffield.	E. Gough - -	Struck on body.
9 November 1897 -	Lockwood Bros., Spital Hill.	No one hurt.	
*20 November 1897 -	Elliott & Co., Hollis Croft.	„ „ - -	Large section of stone flew directly forward and landed in fireplace.
9 December 1897 -	Skelton & Co., Heeley.	F. Bell - -	Bruised and cut.

* In these cases the stone flew directly forward.

Date of Accident.	Firm.	Name of Injured Person.	Injury and Attendant Circumstances.
*12 December 1897 -	Copley's Wheel, Rockingham Lane.	- - -	Stone flew forward, missing fireplace by a few inches, part fell in the road, and another fell on the hearthstone.
*22 December 1897 -	Barker and England, Union Wheel.	John Riches - -	Arm and nose broken, throat injured, and system shaken. Large pieces fell in front of fire.
December 1897 -	Thos. Crownshaw, Union Wheel.	Wilfd. Dungworth -	Half stone rolled on hearth in front of fire; large raddle holes in stone. Man shaken badly, and face injured.
*15 January 1898 -	Carlisle's Wheel -	Workman - -	Leg and foot injured. Stone rotten. Pieces flew forward.
17 January 1898 -	Ibbotson's Wheel, Cambridge Street.	- - -	Stone broke in Revill's hull. Stone unsound.
24 January 1898 -	Jail Wheel, Thomas Street.	No one hurt.	
25 January 1898 -	Long's Wheel, Rockingham Street.	„ „	
„ „ -	Melbourne Works, Cambridge Street.	„ „ - -	Stone found cracked.
8 February 1898 -	Soho Wheel, Bridge Street.	W. H. Jones - -	Struck in abdomen.

FACTS RELATING TO VARIOUS GRINDSTONE ACCIDENTS, MOSTLY OF UNKNOWN DATE, SUPPLIED BY MR. JOHNSON, SECRETARY, TABLE-BLADE GRINDERS' SOCIETY.

Gibbins' Wheel, Oxford Road, Sheffield.

*In May 1892, Thomas Radford was entering a grinding-hull, when he was struck by a flying stone and was killed.

At Lockwood Brothers, Sheffield.

*George Johnson's stone flew, and broke fireplace, position of which has since been altered. Date cannot be ascertained.

*— Wallace. Stone broke; one section flew in the window, the other fell in front of the trough. Date not known.

James Harris. Stone broke; one section flew in window. Date unknown.

Same man (Harris) had another breakage, 18 months ago or more. Section of stone flew in window, another hit the horsing, and knocked him backwards. It is stated that he has never recovered from the injuries then received.

At Ellin's Wheel, Sheffield.

*Henry Gillott was struck by flying grindstone whilst standing in a doorway. This occurred a long time ago, and date cannot now be ascertained.

*E. Brooke. Stone flew just after Whit-week, 1897. It flew in three pieces, one part going to the back, one in the trough, and one straight forward. Man slightly injured.

*James Hibberd. Stone broke two years ago last September, a part flying straght forward.

T. Grafton. "Whittening" stone broke last year. Piece flew straight forward.

At Wragg's Wheel, Denby Street, Sheffield.

*Joe Snape. Stone broke about seven years ago. Pieces flew on hearth, in front of fireplace.

*Same man had a breakage in October 1895. All the pieces flew on hearth.

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* In these cases the stone flew directly forward.

MISCELLANEOUS.

Ward and Payne, West Street, Sheffield.
*Henry Colton was sitting by fire when a stone flew and broke his leg in two places.

Francis Newton and Sons, Portobello, Sheffield.
*Stone broke, and section fell on fireback. Date not known.

Francis Newton and Sons, Portobello, Sheffield.
*Large stone broke. One piece went on hearth. Boy, who often stands there, happened to be elsewhere at the time.

Brunswick Works Wheel, Eldon Street, Sheffield.
*Arthur Snape. Stone broke, went right forward, and broke a wall, 4 feet wide and 6 feet high. Fireplace originally had been there, but had been taken on to the back of hull in consequence of possible danger having been pointed out.

Jos. Rodgers and Sons, Norfolk Street, Sheffield.
*Arthur Gould, table-blade grinder. Father of the deceased stated in evidence that the fireplace was only a few feet from the stone. He did not think the boy was warming himself but he must have been passing in front of the stone. He knew that a proportion of accidents was caused by the presence of fireplaces, but he had always been comfortable about that particular one. It would undoubtedly be less dangerous if the fireplace was put in a different position, as it was almost in front of the grindstone.

* In these cases the stone flew directly forward.

RETURN of ACCIDENTS arising from the BREAKING and BURSTING of GRINDSTONES in the BIRMINGHAM DISTRICT.

Year.	Name of Firm.	Number of Persons Injured.
1896	A. and F. Parkes - -	1
1897	Messrs. Verity - -	1
„	W. H. Butcher & Co. - -	1
„	„ „ -	1

APPENDIX XI.

GRINDSTONES.

Office of Her Majesty's Inspectors of
Factories and Workshops,
21, Fargate, Sheffield, December 23, 1897.

DEAR SIR,

IN addition to the notes in my weekly report, I wish to call your special attention to three cases of breakage of grindstones during the past fortnight. One occurred at Copley's Wheel, Rockingham Lane; the other two cases at the Union Wheel, Alma Street.

In the case at Rockingham Lane a grindstone broke, and part of it flew out into the road. Upon examining it I found that the stone had a natural fault, and also that the material seemed very soft and rotten. In this case the man was not seriously injured.

In the first case at the Union Wheel, the stone was very defective, and showed a large amount of a brown, clayey substance, which the men term "a mucky raddle." This defect could easily have been seen at the quarry; I do not doubt but the quarryman knew of it. This accident might have resulted in the death of two or three men, had they been standing before the fireplace.

In the second case at the Union Wheel (investigated this morning), the quality of the stone was simply shocking. The clayey substance, or "raddle," was clearly visible on the outer surface, and without doubt, was seen by the quarryman, and probably by the grinder. The man who was working on the stone was dashed up against the back wall of the grinding-hull, the horsing and chains flying on the top of him.

His arm and nose were broken, and his throat nearly sawn through by the revolving drum upon which he dropped.

Each of the stones referred to was used with *round* holes in the centre; the pulleys were of the accustomed height, namely, about half the height of the stone; and, as far as I could gather, the workmen were exceedingly careful, sober men. It is a marvel that the man injured yesterday (case 3) was not killed.

One very important phase of these cases is that they had only commenced running quite recently, the periods being, a few minutes, about eight hours, and about eight days, respectively.

You would also like to know that in all three cases large heavy pieces of stone, with their iron plates and axles attached, were thrown right on to the very hearthstone, although the centre of the fireplace was a little more than the proposed limit of three feet from the nearest edge of the stone.

The last-mentioned accident was caused to a man who works for Barker and England, and pays for the use of a stone at the Union Wheel. I understand that the grinders are given a present by the quarry people occasionally, which can only have one meaning,—that the men will not, if they can possibly help it, complain to their employers of the quality of the stones. There are in the yard at the present time four or five grindstones with defects in them, which in my opinion are naturally faulty, inasmuch as thin layers of this clayey substance run in all directions; also, holes are to be seen which have apparently been filled up with sand at the quarry.

I specially wish to draw your attention to these very serious accidents, in the hope that when this question is considered by your Committee, these facts—though only a part of overwhelming evidence—may go to prove what I have repeatedly emphasised, namely, that grindstone accidents are due to the unsuitable and rotten material out of which the stones are quarried.

Yours very truly,
FREDK. J. PARKES,
H.M. Inspector of Factories.

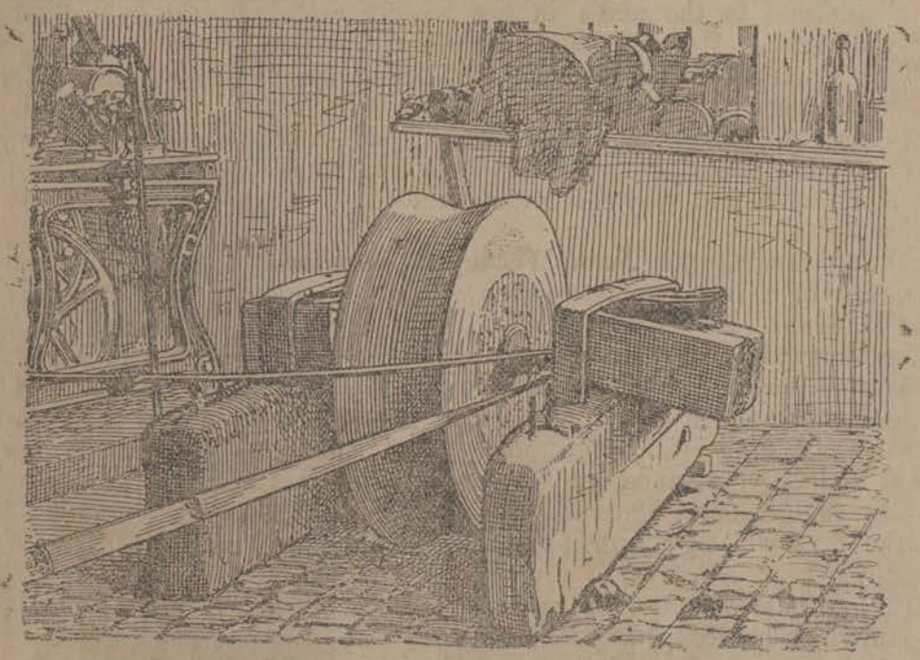
Commander Hamilton P. Smith, R.N.,
Member and Secretary of the Home Office
Committee on Dangerous Trades.

APPENDIX XII.

APPENDIX showing PICTURES OF GRINDSTONES and TESTING ARRANGEMENTS, with REPORT thereupon by Mr. J. H. CRABTREE, H.M. Inspector of Factories, who at that time was Junior Inspector in the Birmingham District, August 1st, 1896.

REPORT.—The TESTING of GRINDSTONES in the Redditch district, Birmingham, August 1st, 1896.

Testing Arrangements at Factory A.

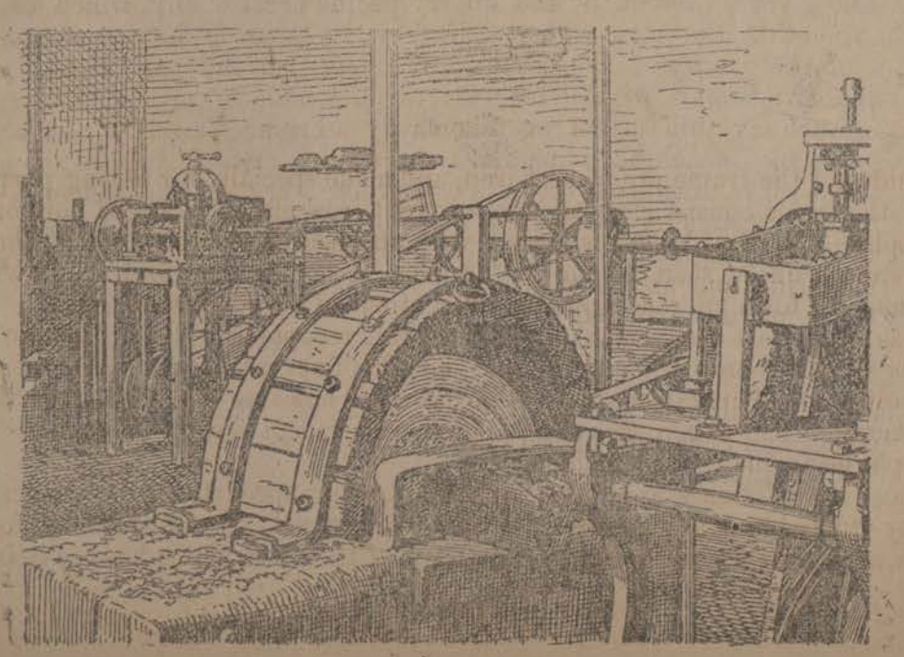


STONE PLACED IN POSITION.

In this arrangement the tram (or trough) consists of three solid logs, which are attached firmly to each other and to the floor. Between the two side logs the spindle of the stone is fixed by means of wedges, a little pulley having been put on the spindle where the strap converges. This pulley varies, according to speed required, from three to six inches in diameter. It is essential, in testing, to have stone perfectly vertical and in the direction of the spindle at right angles to the direction of the driving strap.

The stones used at this factory average about 25 inches in diameter.

Factory B.



GUARD PUT OVER THE STONE.

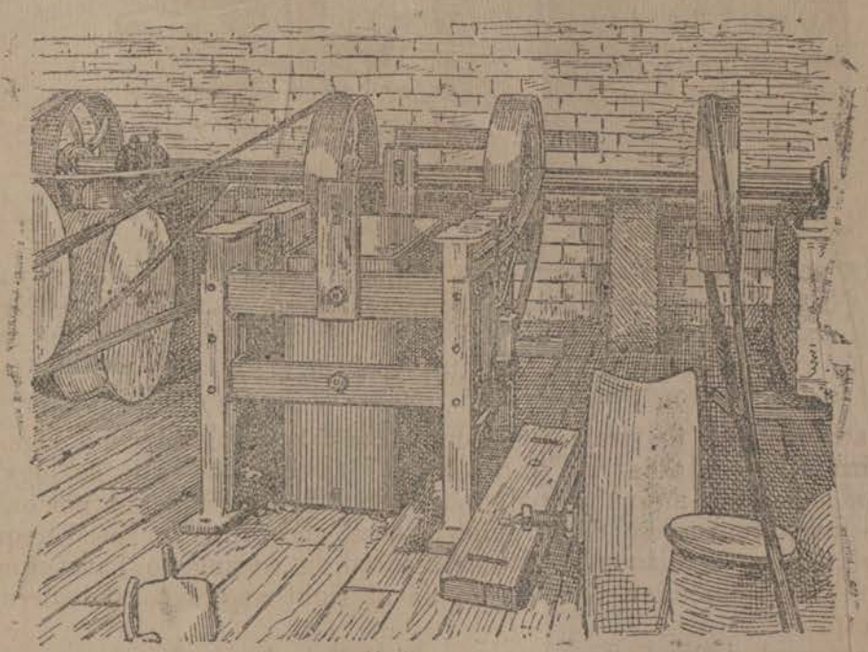
When the stone has been properly posed the guard is adjusted as shown in the wood cut. At one end the wrough-iron girths engage two staples, at the other end they are fastened with nuts and bolts.

The guard is thus constructed :—Several pieces of plank are placed side by side and bolted to two wrought-iron girths so as to completely cover the upper periphery of the stone. The sides of the guard project about two inches on either side of the stone.

The working speed is about 1,000 revolutions per minute ; in *testing*, this is increased to 1,500.

Several stones have broken in the testing, but none have inflicted bodily injury. The testing is carried out during the meal hour, and lasts about 20 minutes for each stone.

Needle Factory C., Redditch.



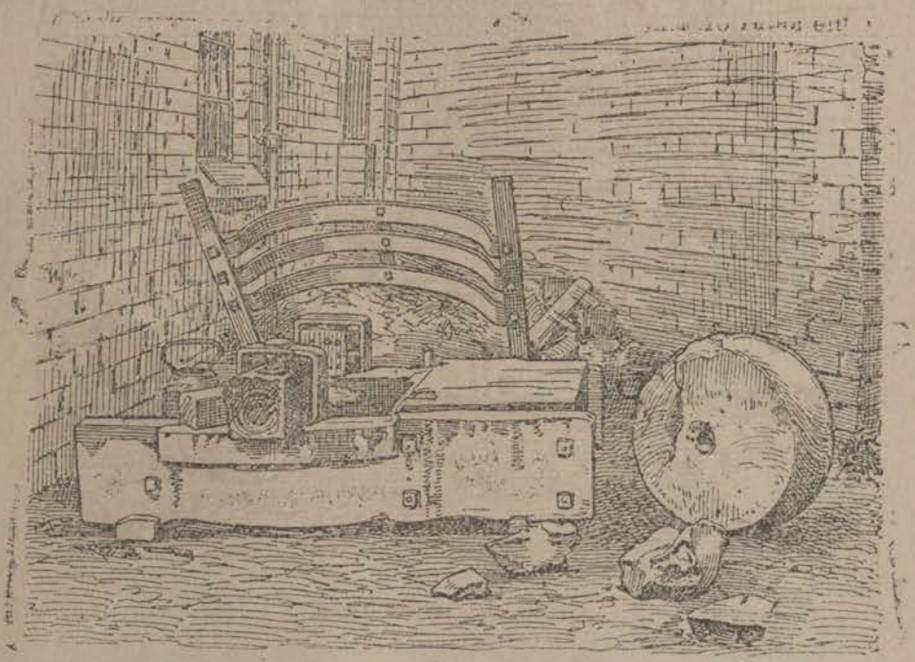
WROUGHT-IRON RECEPTACLE READY FOR STONE.

The sides of the frame are of cast-iron, and made specially for testing purposes. The ends of the frame consist each of two wrought-iron plates arranged horizontally. On the top plate a vertical holder is bolted, with an opening for the cotter. The receptacle for the stone will be seen inside the frame. It consists of four solid wrought-iron plates made to form an oblong *tube*. The stone is fitted with a spindle and 4-inch pulley, as in the last case, and then put into this receptacle. Its bottom is, of course, the floor of the room ; the top is seen on the floor at A, and consists of a 3-inch plank bolted to a 1-inch iron plate. It has two holes to fit on the vertical holders before-mentioned. When this top is put on the receptacle, it is kept in position by cotters placed in the vertical holders.

Average size of stones used is 28 inches; working speed 1,000 ; testing speed 1,500.

Faulty stones break at three-fourths the testing speed. Stones are tested for about five minutes, as required, and men are cleared out of the room whilst a stone is being tested.

Needle Factory D, Studley.



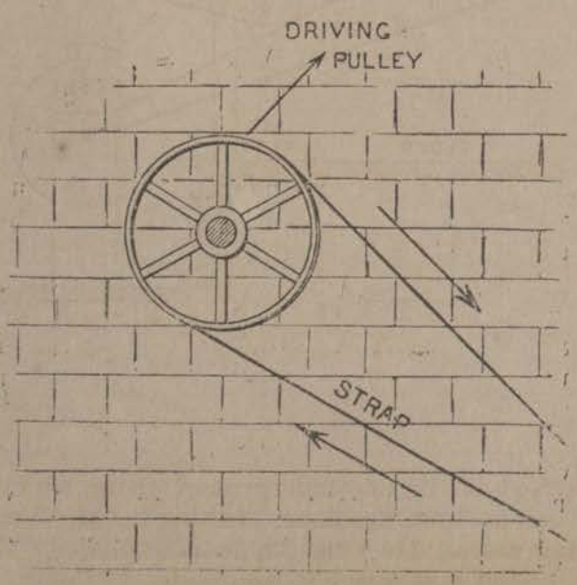
GUARD OFF TRAM.

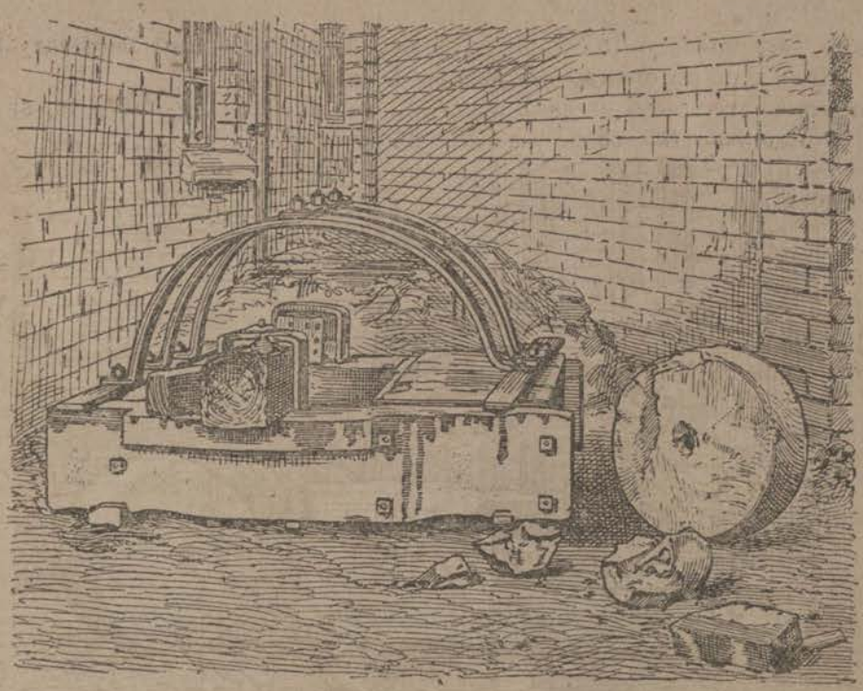
The construction of the tram or trough is similar to preceding cases. It is, however, placed *outside* the factory, and close to the factory premises, so that a pulley placed on the factory main shaft outside the wall is connected by a strap with the small 3-inch pulley on the spindle of the stone. I think this outside position a distinct advantage. In Lance's factory the roof still bears deep marks of the fury of breaking stones during testing, pieces of stone having escaped by the edges of the top plank.

The ordinary passage is a reasonable distance from this tram, so that though the guard is not one of the best, bodily injury is not likely to ensue if stones "fly."

The guard is placed alongside the tram ready for instant use.

Factory D, Studley.





GUARD PLACED ON TRAM.

The guard consists of three semi-circular wrought-iron rods bolted to cross-pieces of wrought iron at the ends and in the middle.

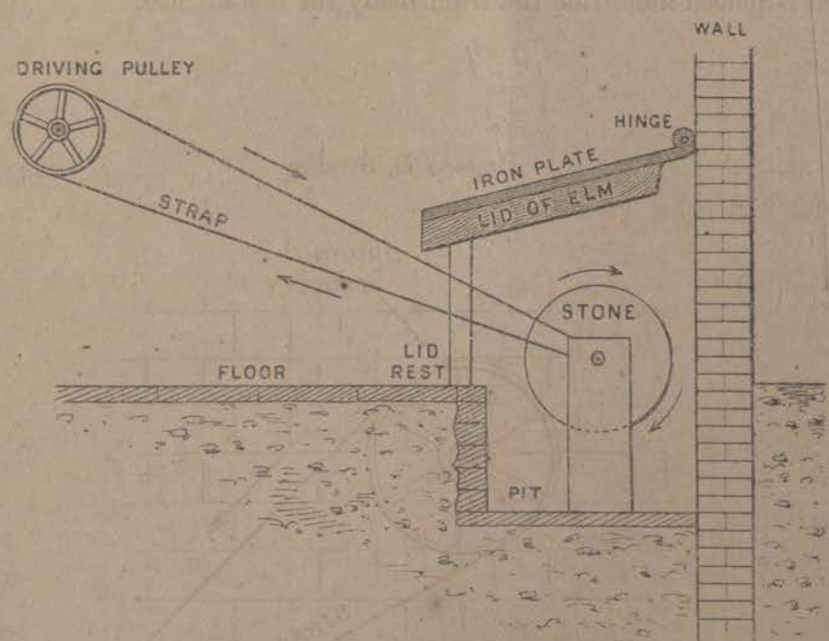
The guard is simply placed on the tram over the stone, and not in any way fastened.

No accidents have occurred, and only one stone has fractured during testing during last three years.

Size of stones = 24 inches.

Working speed = 800. Testing speed = 1200 to 1500.

Needle Factory E, Redditch.



Testing is here carried on in an underground room, which is used for no other purpose. A pit has been made in the floor. In this the stone is fixed to side-supports, exactly as in preceding cases. Over the stone is a hinged lid, consisting of an elm board, 3 inches thick, bolted to a wrought-iron plate, 1″ thick. This is lifted to admit

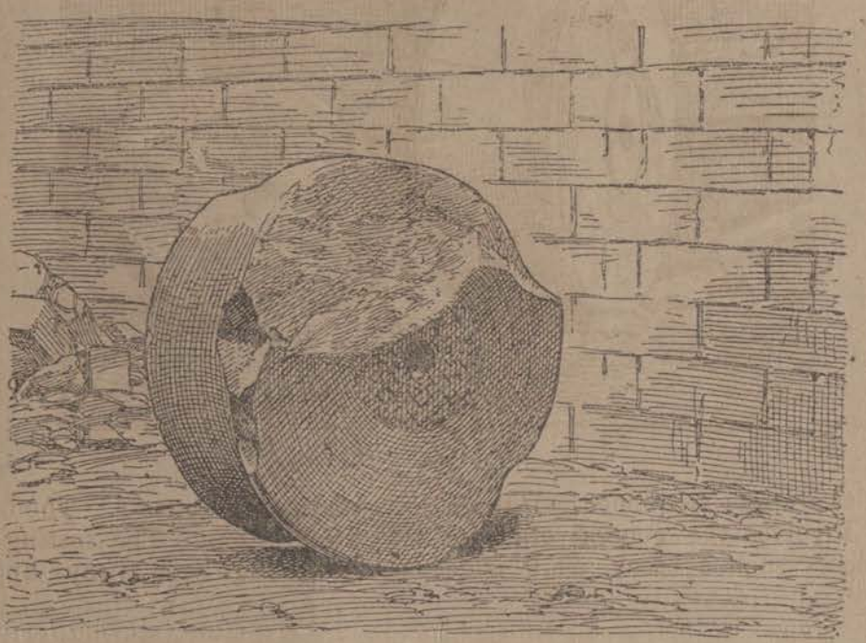
the stone, and then is held in place as in drawing by side rests. A former elm lid of same thickness was smashed to atoms; it was, therefore, found necessary to affix an iron plate. Since then no mishap has occurred.

About ten stones are tested on each occasion, and the driving-pulley is set in motion and stopped from *outside the room* by a lever and a long iron rod.

Size of stones = 25 inches.

Speeds = working, 1,000; testing, 1,500.

Faulty Stones.



When stones are in perfect condition, and are struck with a testing hammer, a distinct metallic ring is produced.

When a faulty stone is similarly struck there is a dead thud, which is equally distinctive.

I found this to be the only test applied at a needle factory,* where the foreman vows he can test any stone by the sound of the testing hammer.

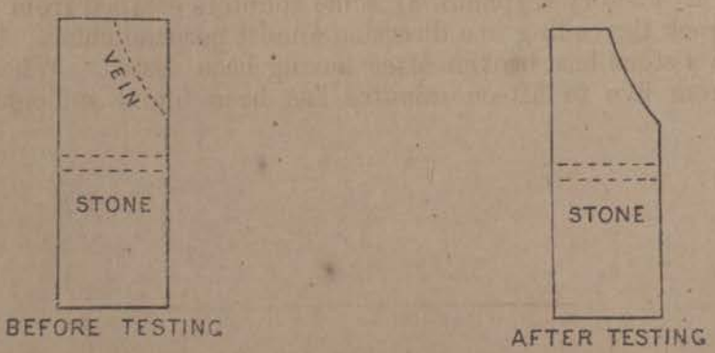
The working-speed here, however, does not exceed 600 or 800.

The "faults" in stones appear to be generally due to two causes:—

(1) A "water-vein," or the presence of a thin layer of soft stone between the harder strata of the stone itself.

(2) Mechanical fracture from centre outwards, or *vice versâ*, effected while the stone is being bored or rounded.

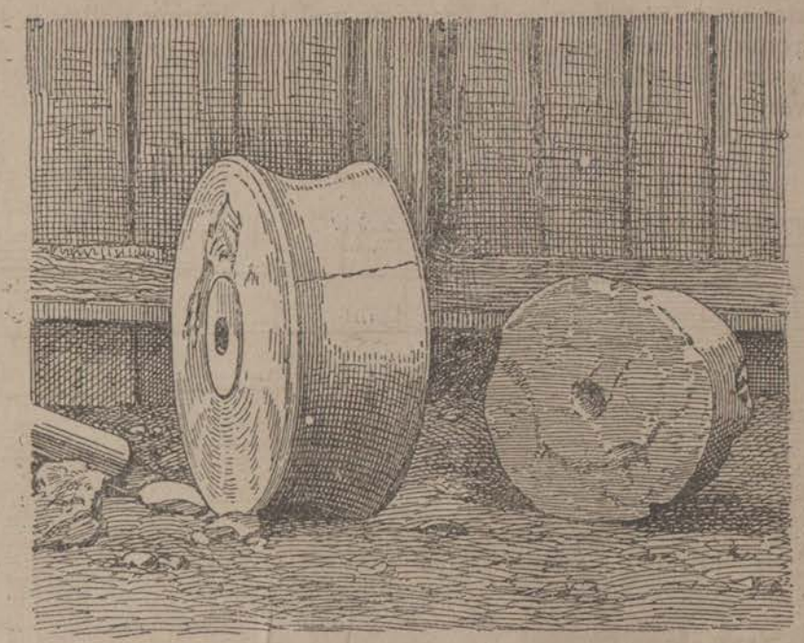
Cause 1.—We have examples of this in photographs 5 and 6. By sounding, the layer of soft stone was detected, and a knock on the edge of the grindstone detached the faulty part, as indicated in the accompanying diagrams.



These sharp side-splits are decidedly dangerous, and will readily fly off at a moderate speed, as the vein prevents the uniform cohesion of the whole mass.

* Mr. Knyvett states that a stone flew in these works last December; this stone *had* been tested.

Cause 2.—The accompanying photograph (No. 7) shows an example. The periphery of the stone reveals a decided crack, which extends towards the centre.



These faults are less frequent than those indicated under Cause 1. The testing of such stones involves the general crash of the whole stone. The testing hammer readily discloses such a crack, as it is deep-seated, though not always apparent to the eye.

My conclusions :—

(1.) Wherever grindstones are used at high speeds (800 or over), testing arrangements should be provided.

(2.) These should be, wherever possible, *outside* the factory, preferably in an enclosed yard of reasonable size, to which unconcerned persons have no admittance.

(3.) Guards should in every case form part of the testing apparatus.

JOHN H. CRABTREE,
August 1, 1896.

APPENDIX.

Results of Testing.

The process of testing has invariably, so far as I have been abie to ascertain by inquiry, detected a faulty stone. In three cases of such stones being tested the crash was tremendous, but the broken pieces did not escape from the testing apparatus.

In a test case at Factory C (photo. 3), some splinters escaped from the side of the receptacle and struck the ceiling in a direction almost perpendicular. I cannot hear of *any* case in which a stone has broken after having been tested. Where stones break during testing, from five to fifteen minutes has been found sufficient to decide the fracture.

APPENDIX XIII.

Mr. Dodgson discusses the dangers attending the use of grindstones :—

"Since being appointed to Sheffield, now four years ago, I have made the subject of the use of grindstones a continual source of inquiry. Fatal accidents, though happily not frequent, do still occur to grinders through the flying or bursting of grindstones occasionally. Various reasons contribute to the bursting stone, and those mostly assigned to the fracture are—weakness of texture of the stone, cracks and flaws, over-speeding, dressing by racing, unequal or jerky running of engine, heavyside, water-logged and frost-bitten stones, wedged axles, and defective or too tightly screwed plates. My investigations of accidents lead me to the opinion that of stones that fly, over 50 per cent. fly within a few minutes' use after a period of prolonged rest (say one night), and that a large proportion of these fly on a Monday morning (probably, too, not more than 10 per cent. of total number of burst grindstones are brought under the notice of an inspector), and that quite 90 per cent. result in no injury to the grinder, from which circumstance one might suppose a special divinity hangs its protective genius around the grinders' lives and limbs—many of them appear to have had a charmed life from their marvellous and hairbreadth escapes. It is a remarkable fact that most stones fly either when the grinder is preparing to mount, or immediately after he has dismounted. Of stones that fly probably not more than 1 or 2 per cent. are dry stones, a very low percentage when the relative number of dry and wet stones are considered. From the last remark I infer that dry stones are safer to work upon than wet ones, with this great compensating disadvantage, that from the dust evolved a dry grinder has several less years to live than a wet grinder—what he gains in security he loses in health. If I may be permitted a digression, I am led to believe that the dry grinder's life, as a result of the application of the Factory Acts to him, with the result of making him use a fan—has appreciated by at least five to ten years, perhaps more, within the last four decades. It is considered dangerous to hang a 'green' stone direct from the quarry. A stone absorbs a considerable weight of water when run in it. A slight flaw of little detriment to a dry stone, might develop into a serious one when saturated with water. And stones, wet or dry, possess but little power of resilience or elasticity—hence an undue strain on a stone will induce a flaw. I give these particulars in view of a proposition that all stones ought to be submitted to a test before using, such test theoretically being that if a stone is hung and submitted to a higher revolutionary speed than when actually in use, ought to be proof (if it stand the strain) that that stone is perfectly safe for ordinary use. Theoretically this argument appears sound, but I can see a score objections, many of them indeed most adverse to this view. If every stone were of the same dimensions, of the same texture, and for the same purpose, and to be used under identical conditions, then there might be an element of safety by taking such a precaution, indeed I understand in some factories, notably devoted to needle and huckle-pin grinding, this precaution is taken. These stones are run dry, a condition perhaps favourable to an over-speed test, but occasionally even these tested stones fly. But stones are run dry and wet. Some are 10 feet in diameter, some a few inches. Some are required or are useable 18 inches thick, others are required less than half an inch. A hard, durable, stone is needed for blade shoulder grinding; a soft, kind, stone is essential for razor grinding; and a medium one for ordinary cutlery. A file grinder, a razor grinder, an auger grinder, a scythe grinder, and a pen-knife grinder, each requires his own particular stone of varying hardness and size; and to accommodate this almost infinite variety who could lay down hard and fast rules for testing, and what authority could supervise the test? The average grinder, knowing he carries his life in his hand, selects his stone with skilful judgment (and nearly every grinder selects his own); he hangs, centres, and dresses it with consummate care and delicacy. He scrutinizes it minutely, sounds it here and there with a hammer, and judges its soundness by the ring; and generally his instinct, grown out of experience, is unerring. Finally he gives the stone a preliminary run, generally of some hours, before using.

"Two persons only are competent to judge the merits of a stone, the grinder who uses it, and the stone dresser at the quarry who produces it, and if it could be proved that a quarry-master has deliberately delivered a defective stone, he or his agent, knowing the same to be defective, I consider blame and penalty should be attached to him.

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Shri Brihad Bhartiya Samaj
on 31 October, 2019

"Let me recommend these points, as precautionary measures, worthy of consideration—

"All flying grindstones, whether resulting in personal injury or not, should be reported to the district inspector.

"All grindstones to bear an imprint of origin, *i.e.*, the quarry-master's name and quarry; this also to be reported to inspector should the stone fly.

"All stones to be securely fixed within proper plates.

"Square axles and square axle holes to be prohibited. Wedged stones also to be forbidden.

"Troughs to be emptied, or the stones to be made clear of water before any prolonged rest.

"That the driving pulley should exceed half the diameter of the stone."